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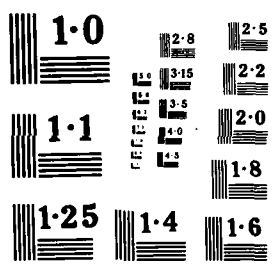
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Final Report

AV-FR-84/593

INSTALLATION RESTORATION PROGRAM
PHASE II - CONFIRMATION/QUANTIFICATION

STAGE 1

REPORT FOR

WILLIAMS AIR FORCE BASE,
CHANDLER, ARIZONA

AIR TRAINING COMMAND
RANDOLPH AFB, TEXAS

PREPARED FOR

UNITED STATES AIR FORCE
OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY (OEHL)
BROOKS AIR FORCE BASE, TEXAS 78235

JANUARY 1986

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION: Unclassified

1b. RESTRICTIVE MARKINGS: N/A

2a. SECURITY CLASSIFICATION AUTHORITY: N/A

2b. DECLASSIFICATION/DOWNGRADING SCHEDULE: N/A

3. DISTRIBUTION/AVAILABILITY OF REPORT: Distribution is unlimited

4. PERFORMING ORGANIZATION REPORT NUMBER(S): N/A

5. MONITORING ORGANIZATION REPORT NUMBER(S): N/A

6a. NAME OF PERFORMING ORGANIZATION: AeroVironment Inc.

6b. OFFICE SYMBOL *(If applicable)*:

7a. NAME OF MONITORING ORGANIZATION: USAF OEHL/TS

6c. ADDRESS *(City, State and ZIP Code)*:
825 Myrtle Avenue
Monrovia, CA 91016

7b. ADDRESS *(City, State and ZIP Code)*: Brooks AFB, Texas 78235-5000

8a. NAME OF FUNDING/SPONSORING ORGANIZATION: Same as 7A

8b. OFFICE SYMBOL *(If applicable)*:

9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER: F33615-83-D-4000

8c. ADDRESS *(City, State and ZIP Code)*:

10. SOURCE OF FUNDING NOS.

PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.	WORK UNIT NO.

11. TITLE *(Include Security Classification)*: IRP Phase II, Stage I Williams AFB

12. PERSONAL AUTHOR(S): AeroVironment Inc.

13a. TYPE OF REPORT: Final

13b. TIME COVERED: FROM 9/84 TO 1/86

14. DATE OF REPORT *(Yr., Mo., Day)*: 1986 January 24

15. PAGE COUNT: 310

16. SUPPLEMENTARY NOTATION:

17. COSATI CODES

FIELD	GROUP	SUB. GR.

18. SUBJECT TERMS *(Continue on reverse if necessary and identify by block number)*:

19. ABSTRACT *(Continue on reverse if necessary and identify by block number)*

AeroVironment Inc. was tasked to conduct a Phase II Stage I investigation at Williams AFB near Phoenix, AZ. The objective was to confirm and quantify the presence and extent of contamination at the fire protection training area #2 (FPTA), liquid fuels storage area (LFSA), surface drainage system - southwest, landfill, pesticide burial area, and surface drainage system - northwest. Drilling and soil sampling were conducted at the FPTA, LFSA, and landfill. Thirty-one holes were drilled in the three areas. Surface soil samples were collected along the two drainage channels. Also, a magnetometer survey was conducted at the pesticide burial area. A total of 272 soil samples were collected.

Of the 272 samples collected, 204 were analyzed in the laboratory. Soil contamination was found at: 1) small burn pit at FPTA, 2) drainage outfall at FPTA, 3) old AVGAS distribution system at LFSA, and 4) southwest drainage system. Magnetic anomalies (buried drums) were identified at the pesticide burial area. Recommendations made for Williams include: 1) remove surface soils from the southwest drainage, 2) excavate and inspect the identified buried materials at the pesticide disposal area, 3) collect additional samples around contamination at the FPTA and LFSA.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT: UNCLASSIFIED/UNLIMITED ☒ SAME AS RPT. ☐ DTIC USERS ☐

21. ABSTRACT SECURITY CLASSIFICATION: Unclassified

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22c. OFFICE SYMBOL: USAF OEHL/TSS

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SECURITY CLASSIFICATION OF THIS PAGE

AV-FR-84/593

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WILLIAMS AIR FORCE BASE,
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JANUARY 1986

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CONTRACT NO. F33615-83-D4000

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This report has been prepared for the United States Air Force by AeroVironment Inc., for the purpose of aiding in the implementation of the Air Force Installation Restoration Program. It is not an endorsement of any product. The views expressed herein are those of the contractor and do not necessarily reflect the official views of the publishing agency, the United States Air Force, nor the Department of Defense.

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PREFACE

This report was prepared by AeroVironment Inc. under task order 5 of contract F33615-83-D-4000. This report is a summary of field activities, data, analysis, conclusions and recommendations prepared as part of the Phase II Stage I IRP investigation of Williams AFB.

The project team primarily consisted of Mr. Douglas Taylor and Mr. Tim O'Gara of AeroVironment Inc. and Dr. C. Dean Wolbach of Acurex Corporation. Mr. Taylor served as project manager, Mr. O'Gara was the field geologist and Dr. Wolbach provided laboratory coordination.

AeroVironment wishes to acknowledge the assistance of Williams AFB personnel, particularly Capt. Ruel Burns, Base Bioenvironmental Engineer. Also, the Phase I report prepared by Engineering Science was used as an information source throughout this project.

This work was accomplished between September 1984 and December 1984. Major Dennis Brownley, Technical Services Division, USAF Occupational Environmental Health Laboratory (USAF OEHL) was the technical monitor.

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SUMMARY

The United States Air Force has developed the Installation Restoration Program to assess the environmental effects of past hazardous material handling and disposal activities. As part of that program, the Air Force assigned a task order to AeroVironment Inc., under contract No. F33615-83-D-4000, to conduct a Phase II study of Williams AFB, Arizona. Williams is located near Chandler, Arizona, about 30 miles southeast of Phoenix.

A Phase II study, using a staged approach, is intended to confirm the information reported in the Phase I report (a record search) and to quantify the presence and extent of contamination at Williams AFB during this stage. AeroVironment was assigned investigation of the following six sites at Williams AFB:

- Fire Protection Training Area (FPTA)
- Liquid Fuels Storage Area (LFSA)
- Surface Drainage System, Southwest (Southwest Drainage)
- Landfill
- Pesticide Burial Area
- Surface Drainage System, Northwest (Northwest Drainage)

In particular, AeroVironment was asked to conduct a drilling and soil sampling program to identify subsurface contamination at the FPTA, LFSA and landfill and to collect a series of samples from surface soils along the northwest and southwest drainage systems using hand tools. Finally, AV was to conduct a magnetometer survey at the pesticide burial area to locate buried pesticide containers.

Location of Sites

Williams Air Force Base was constructed in 1941 and has served as a training facility throughout its history. Pilot training has been the primary activity. A wide variety and significant numbers of aircraft have been based at Williams in support of its training mission.

The fire protection training area is located at the southwest corner of the flightline and has been used for fire training since 1948. The training activities consisted of igniting old fuels or solvents prior to 1968 and only JP-4 since 1968 and then extinguishing the fire, usually before the fuel was completely burned. The liquid fuels storage area is located in the central portion of the base, at the corner of "A" Street and 3rd Street. The LFSA is currently used to store JP-4 in above and below-ground tanks. AVGAS fuel was stored at this site until the changeover to JP-4 fuel in 1961. The southwest drainage system is located along the south edge of the main base complex. It collects and transports storm water from portions of the shop and maintenance areas and liquid wastes from the shops were dumped into this drain in the past.

The landfill covers approximately 34 acres and is located in the extreme southwest corner of the base. It was used until 1976 for disposal of the base's domestic, commercial and shop waste. The pesticide burial area is directly north of the landfill and was used for limited disposal of unwanted pesticide cans and drums. The northwest drainage system is located along the northern edge of the main base complex. It drains storm water from a portion of the flightline and parking apron and has received runoff from several fuel spills and leaks.

Tests Conducted

AeroVironment's project team spent three weeks at Williams AFB completing the field portion of this task order. With the help of a drilling company and a geophysical survey team, field information was collected to determine the presence or absence of contamination at the sites and to estimate the extent of contamination. Laboratory analysis of the collected samples provided specified information on the concentration of contaminants in the soil. In addition to the soil sample collection and analysis, two magnetometer surveys were conducted. A summary of the project activities is shown in Table i.

Summary of Results

Results of the sampling and analysis program show that several locations on the base have been contaminated. Laboratory results show that oil and grease are

TABLE i. Summary of project activities.

Site	Activity	Soil Samples Collected	Total Footage Drilled	Samples Analyzed	Parameters
FPTA	Soil sampling (drill rig)	96	164	81	O&G, phenol, TOX, lead
LFSA	Soil sampling (drill rig)	51	114.5	42	O&G, phenol, TOX, lead
SW drainage	Soil sampling (by hand)	14	NA	14	O&G, phenol, TOX, lead, copper, cyanide, chrome, cadmium, MEK
Landfill	Soil sampling (drill rig)	103	468.5	59	O&G, phenol, TOX, lead, chrome, cadmium
Pesticide burial	Magnetometer survey	NA	NA	NA	NA
NW drainage	Soil sampling (by hand)	8	NA	8	O&G, phenol, TOX, lead, MEK
Waste	Drum sampling	4	NA	4	E.P. toxicity, ignitability

NA = not applicable.

the most common contaminant found at Williams AFB, with lead also common. Total organic halogens and phenol were not found in the majority of samples.

Samples at the FPTA contained oil and grease in concentrations up to 9,500 µg/g in the soil below the small burn pit and 41,000 µg/g in the drainage channel near the separator pit. The contamination in the drainage channel is very limited. Contamination under the burn pit was confirmed, but the extent of the problem was not determined.

Samples near the old AVGAS piping system at the LFSA contained up to 2,500 µg/g of oil and grease and 1,100 µg/g of lead. Contamination extends to at least 45 feet below ground. The areal extent is unknown, because only one boring was placed near the AVGAS system. Other sampling locations showed limited surface contamination from past spills.

The first 50 foot length of the southwest drainage system was found to contain up to 10% oil and grease, 1,500 µg/g of lead, 470 µg/g of chromium, and 90 µg/g of cadmium. Contaminant levels decrease substantially with depth and distance downstream from the head of the channel, but all surface samples showed evidence of contamination.

The magnetometer survey at the pesticide burial area clearly identified ten locations of buried metallic material. These materials are presumed to be pesticide cans or drums. Samples from the landfill and northwest drainage showed no concentrations of contaminants significantly above background levels.

Conclusions and Recommendations

Six sites at Williams AFB were investigated for the presence of chemical contamination during this study. Two of these sites, the landfill and northwest drainage system, do not warrant any additional investigation or remedial activity. The southwest drainage system and the pesticide burial area were found to be contaminated and the extent of that contamination is thought to be well defined. Remedial activities are considered appropriate as the next action at these sites,

particularly immediate removal of soil at the southwest drainage system. The other two sites investigated, the fire protection training area and the liquid fuels storage area, were found to contain localized areas of contamination; however, in Stage I of the Phase II study, we were unable to define fully the lateral or vertical extent of migration. As a result, additional sampling and laboratory analysis are appropriate at these sites.

Specific recommendations are summarized in Table ii.

TABLE ii. Summary of recommendations.

o	Fire Protection Training Area
	- Drill up to 10 borings, sampling to determine extent of contamination near the burn pits; total drilling up to 200 feet - Drill two deep borings to determine whether a clay layer underlies FPTA (up to 200 feet) - Sample soils directly above the clay layer, if found (four samples) - Analyze soil samples for oil and grease, up to 84 samples - Analyze the most badly contaminated samples for priority pollutants, up to five samples - Revise FPTA area to reduce additional application of contaminants - Remove contaminated soil from the drainage channel south of the separator pit (approximately 5 cubic yards)
o	Liquid Fuels Storage Area
	- Drill up to 15 borings, sampling to determine the extent of contamination along the old AVGAS system; total drilling up to 750 feet - Drill two deep borings to determine whether a clay layer underlies LFSA (up to 200 feet) - Sample soils directly above the clay layer, if found (four samples) - Analyze soil samples for oil and grease and lead, up to 154 samples - Analyze the most badly contaminated samples for priority pollutants, up to five samples - Place vapor monitoring wells under the contamination zone, if appropriate

TABLE ii. (Continued)

o	Southwest Drainage System
	- Immediately excavate and remove soils, to a depth of two feet, from the upper 50 feet of the channel (approximately 12 cubic yards); handle as hazardous waste - Excavate surface soil from the remainder of the channel and place it in hardfill or landfill areas; refill channel with clean soil
o	Landfill
	- No further action
o	Pesticide Burial Area
	- Excavate the ten identified magnetic anomalies (buried metals) and determine whether any are pesticide drums or cans - Dispose of excavated material in an appropriate manner - If needed, drill up to ten borings (200 feet total) and collect up to 40 samples to assess the impact from any pesticide leakage
o	Northwest Drainage System
	- No further action

I. INTRODUCTION

A. Purpose of the Program

The United States Air Force (Air Force) has developed the Installation Restoration Program (IRP) to identify and evaluate environmental contamination from past handling and disposal of hazardous materials at Air Force Bases (AFB). AeroVironment (AV) was retained to provide consulting services for the IRP under contract F33615-83-D-4000. Under that contract, AV was tasked to conduct a Phase II investigation of Williams AFB, Arizona. The stated objectives of that task order are:

(1) To determine the presence or absence of contamination within the specified areas of investigation.

(2) If contamination exists, to determine the potential for migration of those contaminants in the various environmental media.

(3) To identify additional investigations necessary to determine the magnitude, extent, direction and rate of migration of discovered contaminants.

(4) To identify potential environmental consequences and health risks of migrating pollutants.

More specifically, AV was tasked to collect soil samples from various depths around identified sites, to analyze those samples and to conduct a geophysical survey at a burial site on the base. In the Phase I IRP study, six priority sites were identified at Williams AFB (see Figures I-1 and I-2). These sites were all thought to be potentially contaminated with hazardous substances, due to past practices in handling or disposing of hazardous material. These sites, in the order of their priority, are

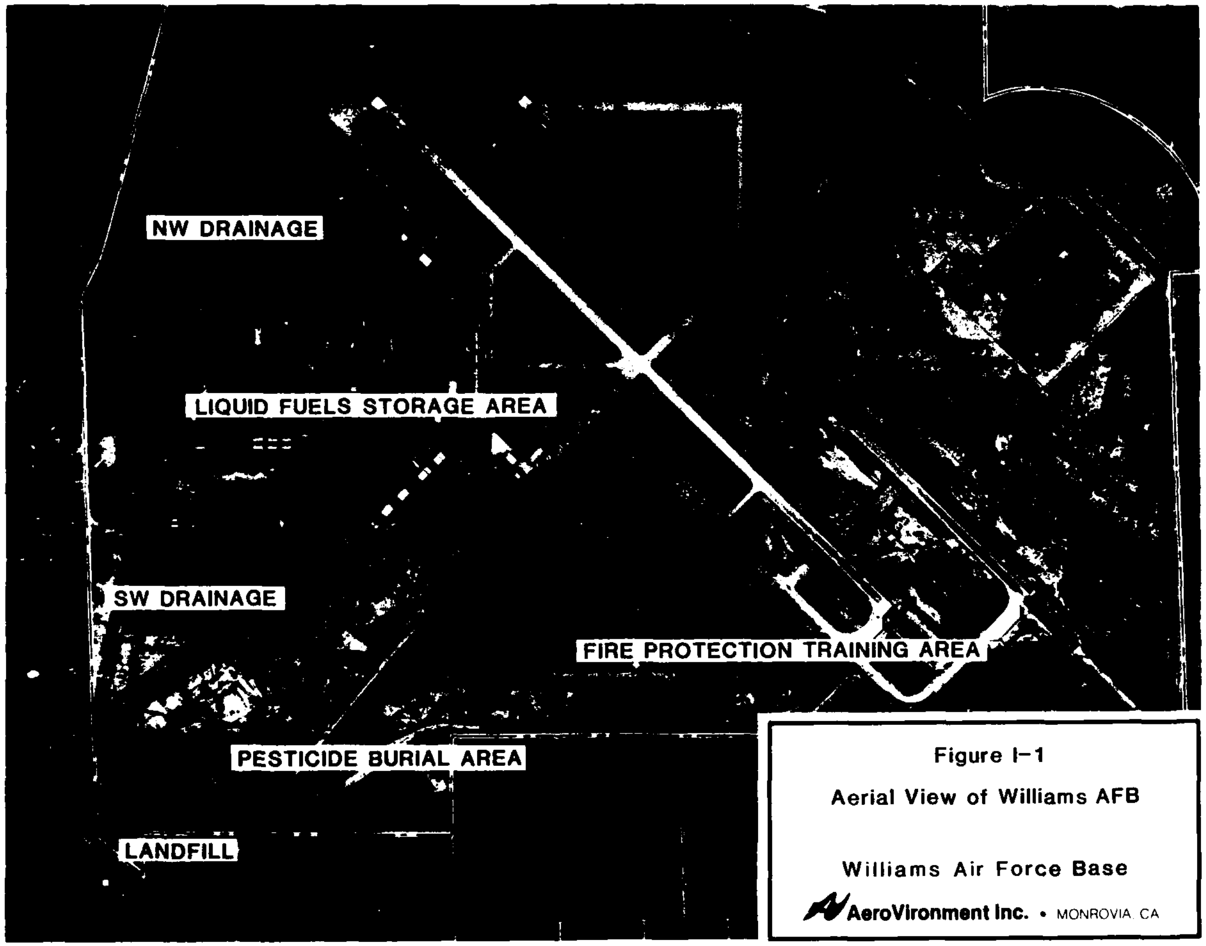

Figure I-1

Aerial View of Williams AFB

Williams Air Force Base

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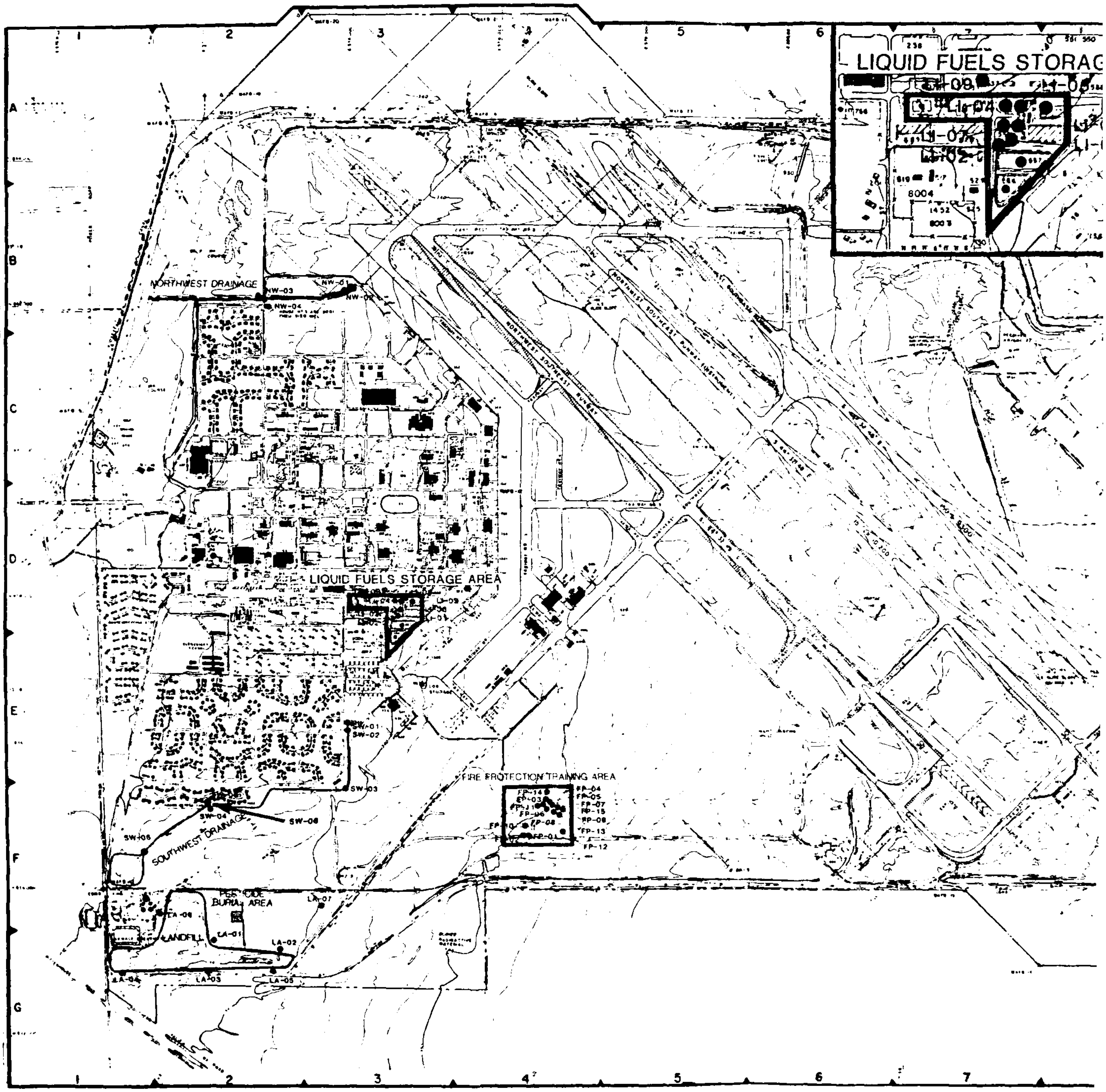
Date Unknown



LIQUID FUELS STORAG
NORTHWEST DRAINAGE
NW-03
NW-04
NW-02
LIQUID FUELS STORAGE AREA
SW-01
SW-02
SW-03
SW-04
SW-06
SW-05
SOUTHWEST DRAINAGE
FIRE PROTECTION TRAINING AREA
FP-04
FP-05
FP-07
FP-15
FP-09
FP-13
FP-12
FP-01
BURIAL AREA
LANDFILL
LA-01
LA-02
LA-03
LA-04
LA-05
LA-06
LA-07

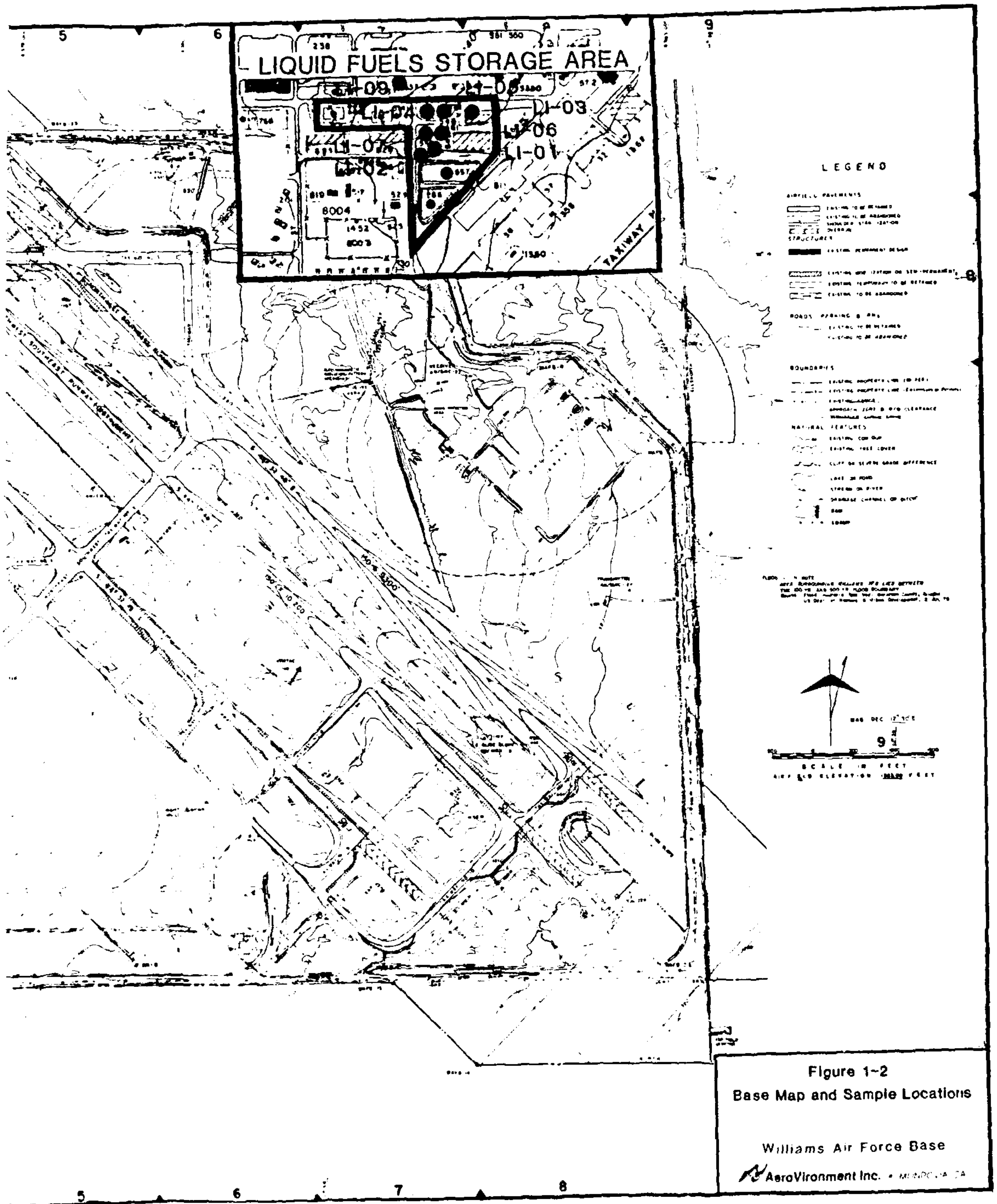


Figure 1-2
Base Map and Sample Locations

Williams Air Force Base

AeroVironment Inc.

December 1984

- Fire Protection Training Area No. 2 (FPTA)
- Liquid Fuels Storage Area (LFSA)
- Surface Drainage System, Southwest (southwest drainage)
- Landfill
- Pesticide Burial Site, and
- Surface Drainage System, Northwest (northwest drainage)

At the FPTA, LFSA, and landfill, AV collected subsurface soil samples using a hollow stem auger drilling rig. Surface soil samples were collected with a hand auger at the two drainage systems and a magnetometer survey was completed at the pesticide burial area.

AeroVironment accomplished most of the stated objectives of this task order. We have determined which of the sites or subsites are contaminated, based on the laboratory analysis of soil samples collected at Williams AFB. These analysis results are discussed in detail in Chapter IV. Based on the sampling results and the geologic information gathered during drilling, we have made some determinations as to the extent and migration of the identified contamination. The magnetometer survey located pockets of ferromagnetic material, presumed to be drums or cans of pesticide.

This report identifies additional work deemed appropriate at some of the sites. This additional work will allow more informed decisions regarding final actions under IRP Phase IV. AV has attempted to identify the overall potential for impairment of human health or the environment. This portion of the task could not be completed, because the full extent of the contamination has not yet been defined.

B. Duration of the Program

The presurvey of Williams AFB was conducted on May 15, 1984, and the presurvey report was filed on June 12, 1984. Information was requested from USAF and received by AV regarding drilling permits, maps, etc. in the period from June to September. Bidding for subcontracting was also completed during that

period. Verbal authorization to begin the survey work was received on September 12, 1984. From September 12 to September 24, final details of logistics, equipment, subcontracts and site access were worked out.

AeroVironment and its drilling and geophysical subcontractors were on-site at Williams AFB for fourteen days. Field work commenced September 24 and was completed on October 11, 1984. All field activities were successfully completed. A daily log of field activities is included in Section III B.

Laboratory analysis of soil samples was conducted by Acurex Inc. Samples were sent from the site throughout the three week field period. The laboratory began receiving samples on September 27, 1984. The first report of analysis results was filed on November 2, 1984, and all analyses were completed on December 17, 1984 (with the exception of methyl ethyl ketone analysis).

Report preparation was begun after field work was completed. This document is the culmination of the report and impact analysis task of this project.

C. Base History

Williams Air Force Base was constructed on 4,127 acres of government land in 1941 and immediately served as a flight training school. Training activities with jet aircraft were started in 1949. Throughout its history, pilot training has been the primary activity at Williams AFB. At various times, bombardier, bomber pilot, instrument bombing specialist, and fighter gunnery training schools were also housed on base. Over the years, a wide variety and significant number of aircraft have been based at Williams AFB. Current aircraft at Williams AFB include the T-37, T-38, and F-5.

1. Fire Protection Training Area No. 2

This fire protection training area has served the base from 1948 to the present. Prior to 1948, the area was used as a parking apron. From 1948 until the late 1960's, this site was an unlined burn pit used to burn large quantities

of the combustible liquid waste generated at Williams AFB (see Figure I-3). The fires were then extinguished as part of fire training.

Not all the flammable materials were burned, and remaining combustibles and water were left to infiltrate or evaporate. These wastes included waste fuels, oils, lubricants, cleaning solvents and some paint stripper. Although water was applied to the soil before each burn and may have minimized the total impact of the waste application (by hydrophobic repulsion), the total volume that may have percolated into the ground over the years is reported by the Air Force to be substantial. Current operations, starting in 1983, use a concrete liner under the burn pits, but overflow from the pits is still allowed to percolate into the ground. Overflow occurs because there is no drain mechanism in the burn pit. Water is applied as part of the fire fighting process (water based foam) and fills the liner. The remaining unburned hydrocarbons float on top of the water and either flow over the liner lip or are blown over by wind action (if water level is very close to the lip).

2. Liquid Fuels Storage Area

The liquid fuels storage area has been operating since the base was constructed in 1941, and has been subjected to several spills and leaks of 1,000 gallons or more each in recent years. These have all occurred within the areas of facilities 538, 548 and 555, and they were generally allowed to percolate into the ground (see Figure I-4). The site has also been used to dispose of residues removed from periodic fuel tank cleaning operations.

The Air Force is reported to have abandoned approximately 3,600 ft of four and six inch pipe in the ground when the fuel delivery system was updated in 1961. Using old Air Force plans, AV has determined that up to 4,400 gallons of fuel would have been left in the pipes, if they were capped and abandoned without draining. Additionally, a 12,000 gallon underground tank (Tank 11) was abandoned in area 548. If not completely drained, these abandoned lines could contribute a large volume of fuel to the soil when they are rusted through.

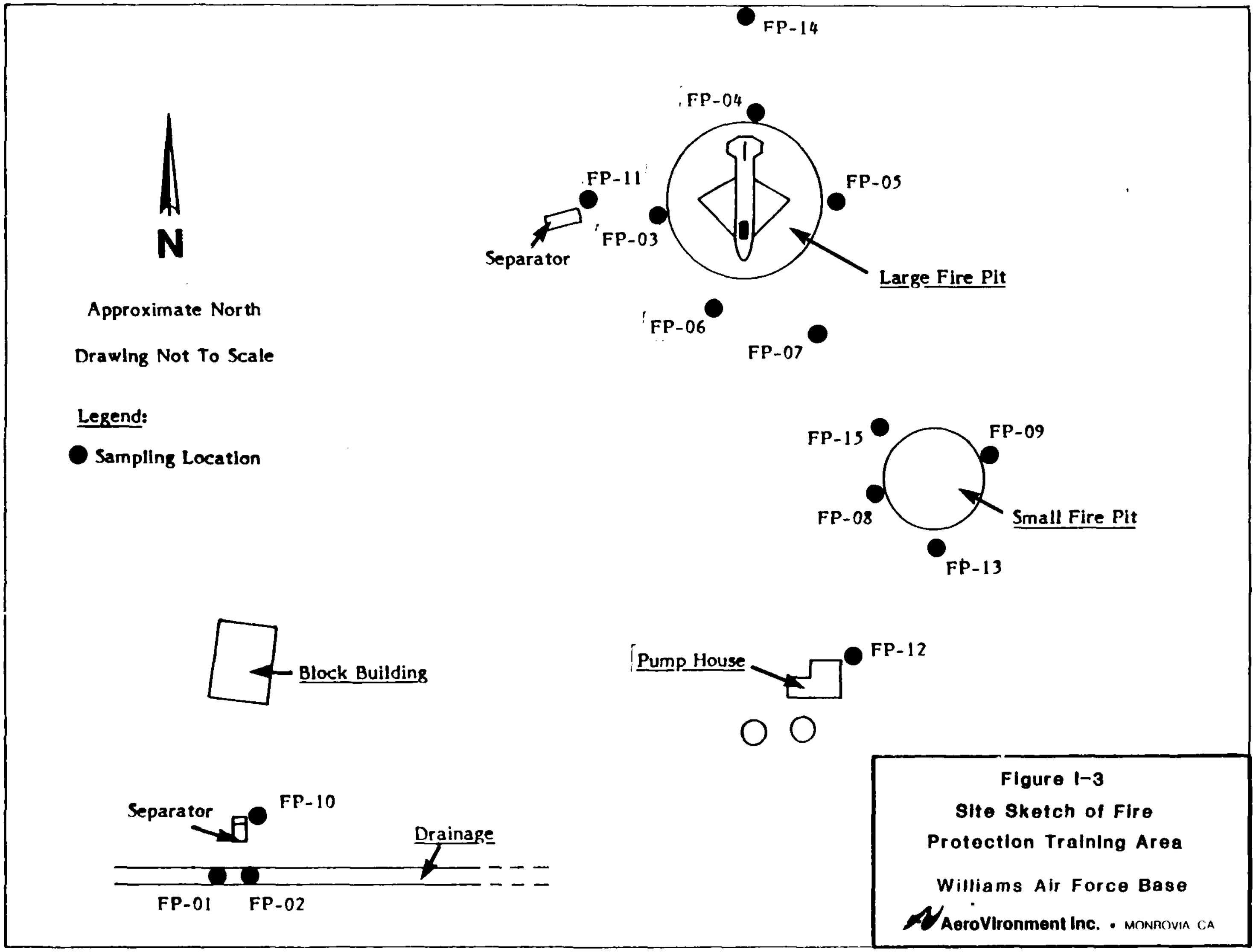


Figure I-3
Site Sketch of Fire Protection Training Area
Williams Air Force Base
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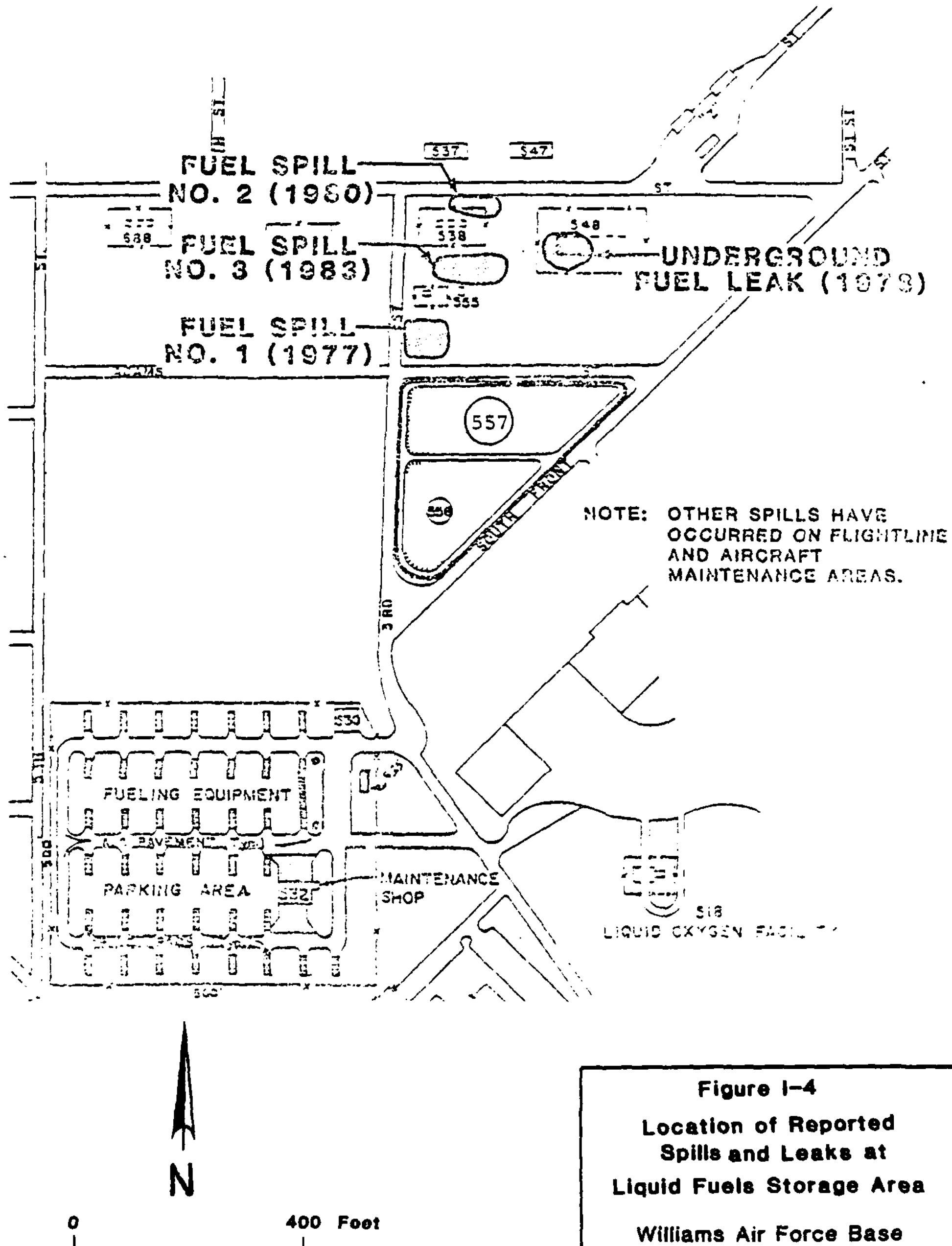

Source: Engineering Science Phase I IRP report, February 1984.

Figure I-4

Location of Reported Spills and Leaks at Liquid Fuels Storage Area

Williams Air Force Base

AeroVironment Inc. MONROVIA CA

December 1984

3. Landfill

The landfill is located in the southwest corner of the base. During its operation, from 1941 to 1976, the landfill received Class II waste, mainly trash and garbage. As is the case with most old sanitary landfills, unknown quantities of hazardous waste were dumped along with the domestic trash material.

4. Pesticide Burial Site

During the years between 1968 and 1972, outdated pesticides were buried at this site. Drum burial operations were carried out four or five times during this period and signs were erected marking the general location of the burials. This site is very small and is situated in the southwest corner of the base near the landfill.

5. Surface Drainage System, Southwest

This drainage system has operated since the base was constructed in 1941. It has received plating shop rinse water, aircraft washing wastes, and miscellaneous aircraft and vehicle spills from flight line and maintenance operations.

6. Surface Drainage System, Northwest

This drainage system serves a portion of the flight line and has served the base from 1941 to the present. The spills washed into this drainage system have included aircraft washing solutions and possibly aircraft stripping and shop wastes.

D. Description of Sites

Williams Air Force Base is located approximately 30 miles southeast of Phoenix, Arizona (see Figure I-5). The base is bounded by irrigated farm land or desert on all sides. Several ranges of mountains are within 11 to 35 miles of the base in all directions. A topographic map of the base is included as Figure I-2.

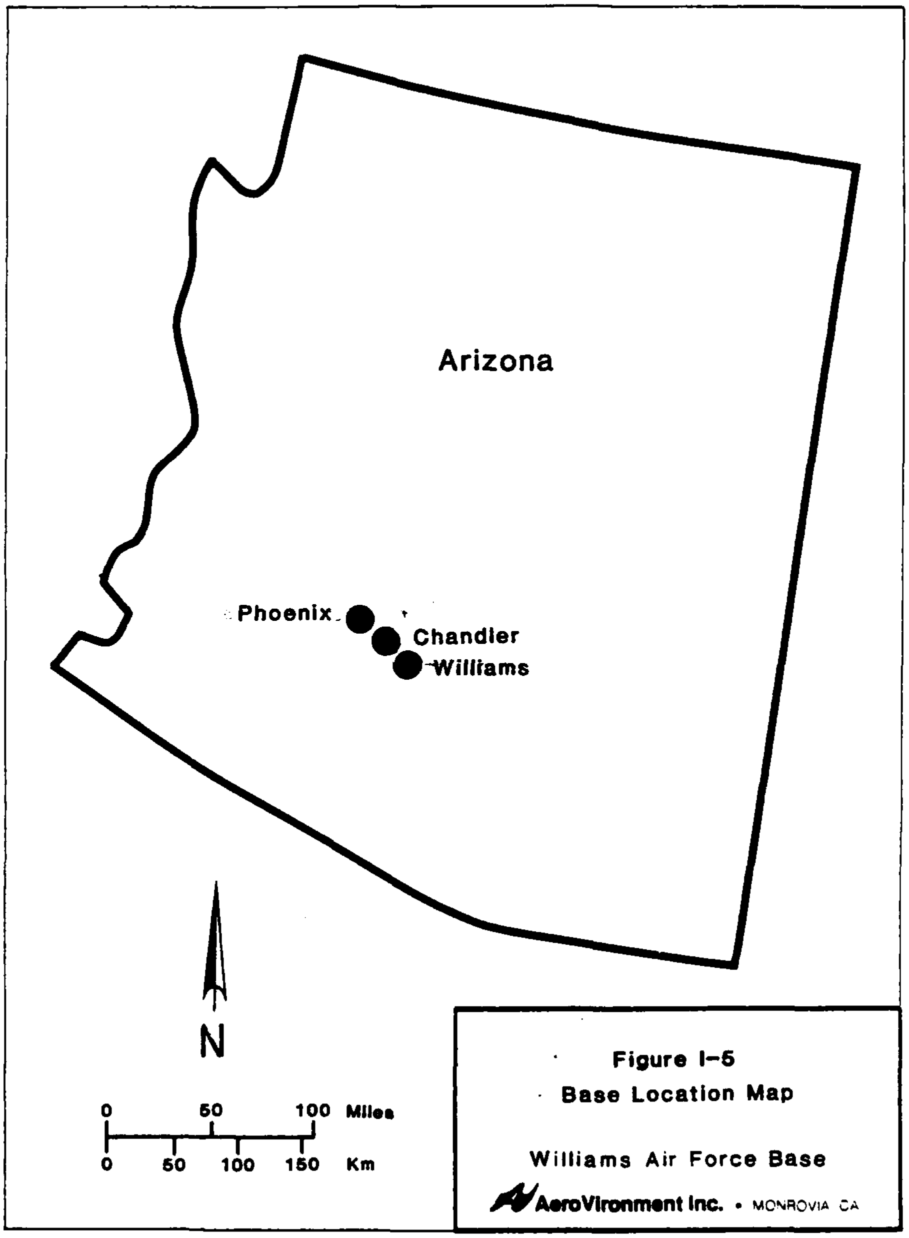

Figure I-5
Base Location Map

Williams Air Force Base

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December 1984

The fire protection training area is located on approximately 8.5 acres near the southern boundary of the base. The nearest building (No. 1546) is about 1,600 ft to the northwest and the nearest living quarters are about 3,000 ft to the west.

The liquid fuel storage area encompasses building/area Nos. 548, 549, and 555, as well as two large aboveground tanks (No. 556 and 557). The total site covers 4.4 acres, but this investigation focused on about 2.8 acres where spills and leaks are thought to have occurred. On-base housing is within 700 ft of the study site, and Air Force personnel regularly work in this area.

The southwest surface drainage runs for about 3,400 ft around the southern edge of the active base housing. The width of the channel is normally 15 ft. The open channel is within 100 ft of living quarters for 85% of its length. The site presents the possibility of dermal contact to personnel working/playing in the channel.

The landfill covers 34 acres in the southwest corner of the base adjacent to the waste water treatment plant. The nearest living quarters are 1,200 ft to the north. The area is posted as "off limits."

The pesticide burial area is in the same general area as the landfill in the southwest corner of the base. The site is very small, less than 0.4 acre, and is 1,100 ft from any work station and 1,500 ft from living quarters.

The northwest drainage system is about 2,100 ft long and is located in the northwest corner of the base, running along the northernmost section of base housing and then through the base golf course. The channel is about 5 ft below grade and 20 ft wide. The open channel is in close proximity to living or working areas for most of its length.

E. Identification of Laboratory Parameters

The purpose of this base investigation was primarily to determine the presence or absence of soil contamination at each of the designated sites. Previous

reports showed that each site had a unique set of possible contaminants and recommended special analytical tests to be run on the various samples. These recommended analyses were included in the Air Force work order and are included as Table I-1.

F. Identification of Field Team*

The field investigation team assembled by AV for the Williams AFB study included AV employees, a drilling contractor and a geophysical investigation team from the University of Arizona, Tucson. The AV team consisted of the following professionals:

- D.B. Taylor, P.E., Project Manager -- Hazardous Waste Program. M. Engr., Environmental Engineering, five years experience in hazardous waste management and cleanup. Mr. Taylor has managed numerous EPA- and privately-funded site investigations.

Mr. Taylor served as project manager for the Williams study. In this capacity he was the main AV interface with Air Force personnel. While in the field, Mr. Taylor was responsible for selecting borehole sites and insuring that proper chain of custody procedures were followed. He also served as site safety officer.

- T.F. O'Gara, Hydrogeologist -- Environmental Programs Division. B.A. Earth Science, five years experience in groundwater monitoring and hazardous waste investigations. He has directed drilling and soil sampling programs at numerous hazardous waste sites.

*Complete resumes for the AV field team are included as Appendix I.

TABLE I-1. Analytical parameters for soil sample extracts, Williams Air Force Base.

LIST A (Fire Protection Training Area No. 2 and Liquid Fuels Area)	LIST B (Surface Drainage System -- Southwest)
Total Organic Halogens Oil and Grease Phenols Lead	Total Organic Halogens Cadmium Chromium Copper Cyanide Lead Methyl Ethyl Ketone Phenols Oil and Grease
LIST C (Landfill)	**LIST D (Surface Drainage System -- Northwest)**
Total Organic Halogens Oil and Grease Phenols Lead Chromium Cadmium	Total Organic Halogens Oil and Grease Phenols Lead Methyl Ethyl Ketone

December 1984

Mr. O'Gara was responsible for drilling supervision and sample collection during the Williams study, as well as geologic interpretation of formations encountered.

- D. Bush, Quality Assurance Engineer -- Environmental Programs Division. B.S. Atmospheric Science, four years experience in air quality monitoring and QA/QC. Mr. Bush has supervised the QA program for studies sponsored by major industrial clients and the U.S. Environmental Protection Agency.

Mr. Bush was on site during the early part of the field program to help with sample collection and documentation.

Drilling was performed by Heber Mining and Exploration Company of Phoenix. This company was formed in 1981, but the staff of drillers and helpers draw on hollow stem auger and soil sampling experience dating back to 1961. Heber has conducted many similar drilling programs, including several at or near Williams. Heber provided a truck-mounted hollow stem auger drilling rig and conducted the actual drilling, as directed by AV personnel.

The magnetometer survey was conducted by Mr. David Dietz and Ms. Frances Roth, both graduate students in the Department of Geosciences at the University of Arizona, Tucson. Field work was monitored by Mr. Taylor and Mr. O'Gara, as necessary. Data interpretation and report preparation was supervised by Dr. Clem Chase of the University of Arizona's Geosciences Department.

G. Other Pertinent Information

The major concern in most soil contamination studies is groundwater pollution after the contaminants percolate into the water table. The following facts will be helpful in assessing the data to be presented in this report as they relate to possible groundwater contamination.

- There are two water-bearing zones which underlie all or part of Williams AFB: (1) a perched water zone under the western half of the base at about 200 feet and (2) a regional, deep, confined aquifer that has a piezometric surface of about 400 feet. This interpretation of the hydrostratigraphic units is taken from USGS Water Resources Investigation 78-61, Open File Report.

- The base is located in an arid environment in south-central Arizona. The effective precipitation is -65 inches per year.

- The contaminated areas on base are relatively small and localized, the largest study site being the 34 acre landfill on a 4,127 acre base.

The significance of these conditions will be discussed further in Chapter IV.

II. ENVIRONMENTAL SETTING[1]

A. Physical Geography

Williams AFB is approximately 30 miles southeast of Phoenix, Arizona, in the East Basin of the Salt River Valley Basin. The Salt River Valley Basin is part of the Basin and Range Physiographic Province, characterized by north to northwestward-trending, wide, flat alluvial-filled basins that surround and separate steep and rugged low-relief mountain ranges. The basin is bounded by the McDowell, Usery, Superstition, Santan, South and Phoenix mountains.

Williams is in the Gila River drainage basin, which is a tributary to the Colorado River. The Gila River originates in southwest New Mexico and flows generally westward to its confluence with the Colorado River approximately four miles upstream from the Mexican border. The Gila River is about 15 miles south of the base. The Salt River, a major tributary to the Gila, is approximately 13 miles north of the base. Flow in the Gila and Salt Rivers is intermittent in the region.

The area around the base has historically been agricultural, but is now becoming urbanized. The greatest urbanization is occurring west and northwest of the base.

1. Topography

The terrain at Williams AFB slopes gently to the west. The highest area on the base is about 1,390 feet above mean sea level (MSL). This area is located at the southeast corner of the base. The lowest area is approximately 1,326 feet MSL along the west side of the installation. The land slope on the base is approximately 0.4 percent.

Because of the low-to-moderate, one-year, 24-hour rainfall intensity at the base, coupled with the flat terrain, erosion potential is low.

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[1]Sections A, B, E, F and G of this Chapter were derived largely from Chapter 3 of the Phase I IRP report (Engineering Science, 1984) prepared under contract to the USAF.

Flooding at the base can be expected to be minimal. The installation lies between the 100-year and 500-year flood level for streams in the Gila River Basin (U.S. Department of Housing and Urban Development, 1979).

2. Soils

Two soil associations are prevalent on the base. The Mohall-Continue Association covers most of the northern half of Williams AFB. This soil association consists of clay, clay loam and loam with a reported permeability on the order of 10^{-4} centimeters per second (cm/sec). The Gilman-Estrella-Avondale Association covers the southern half of the base. This soil association consists of clay loam, sandy loam and loam with a reported permeability of approximately 10^{-3} cm/sec. Since the soils on the base are reported to be moderately permeable, there is a good potential for infiltration of rainfall and runoff.

B. Regional Geology

Underlying Williams AFB are Precambrian age rocks, volcanic rocks believed to be of Tertiary age, and alluvial deposits of Tertiary and Quaternary ages. The Precambrian rocks form the basement upon which the younger geologic materials were deposited. The depth below land surface to these rocks in the vicinity of the base is unknown. Overlying the Precambrian rocks are the volcanic rocks. The depth below land surface to the volcanics is approximately 6,600 feet in the vicinity of the base (EG&G Idaho, 1979). Alluvial deposits overlie the volcanic rocks.

The alluvial deposits at the base include unconsolidated alluvial deposits overlying consolidated alluvium (Arizona Bureau of Mines, 1969). The unconsolidated deposits consist of interfingering layers of sand, gravel, silt and clay. The consolidated alluvium consists of claystone, siltsone, sandstone and anhydrite.

The upper 1,000 feet of alluvial deposits is of greatest interest. Water from these deposits is used to supply the base. Sand, gravel, clay and sandy clay are the dominant lithologies on the west side of the base. The lithologic logs for base water supply wells located on the west side of the base are given in Table II-1.

TABLE II-1. Lithologic logs -- WAFB water supply wells.

Well No. 4	
0 ft. to 12 ft.	Soil
12 ft. to 115 ft.	Clay and gravel
115 ft. to 185 ft.	Sand and gravel
185 ft. to 240 ft.	Sand and gravel streaks of clay
240 ft. to 335 ft.	Coarse sand, gravel and clay
335 ft. to 365 ft.	Clay and gravel
365 ft. to 405 ft.	Clay and sand
405 ft. to 415 ft.	Sandy clay and gravel
415 ft. to 470 ft.	Sand and gravel, streaks of clay
470 ft. to 482 ft.	Clay and rocks
482 ft. to 530 ft.	Dirty sand and clay
530 ft. to 602 ft.	Clay
602 ft. to 635 ft.	Coarse sand and clay
635 ft. to 670 ft.	Clay streaks of sand
670 ft. to 695 ft.	Sand and gravel, streaks of clay
695 ft. to 710 ft.	Hard sand and gravel
710 ft. to 760 ft.	Sandy clay
760 ft. to 785 ft.	Brown sandy clay and gravel
785 ft. to 860 ft.	Sandy clay
Well No. 5	
0 ft. to 10 ft.	Soil
10 ft. to 20 ft.	Sand
20 ft. to 35 ft.	Sandy clay
35 ft. to 45 ft.	Coarse sand
45 ft. to 95 ft.	Coarse sandy clay
95 ft. to 260 ft.	Coarse sand, gravel streaks of clay
260 ft. to 398 ft.	Clay, streaks of sand and gravel
398 ft. to 512 ft.	Sand, gravel and streaks of clay
512 ft. to 1,000 ft.	Sandy clay
Well No. 6	
0 ft. to 15 ft.	Soil
15 ft. to 38 ft.	Sand, gravel and clay
38 ft. to 145 ft.	Sand, clay and gravel
145 ft. to 202 ft.	Sand, clay and gravel streaks
202 ft. to 276 ft.	Streaks of sand, clay, gravel and hard sand
276 ft. to 369 ft.	Clay with streaks of gravel and hard sand
369 ft. to 755 ft.	Brown sandy clay with streaks of gravel
755 ft. to 810 ft.	Sandy clay with streaks of gravel and hard sand
810 ft. to 1,000 ft.	Clay with streaks of sand and gravel
Ordnance Storage Area Well	
	No lithologic logs available

1. General Hydrogeology

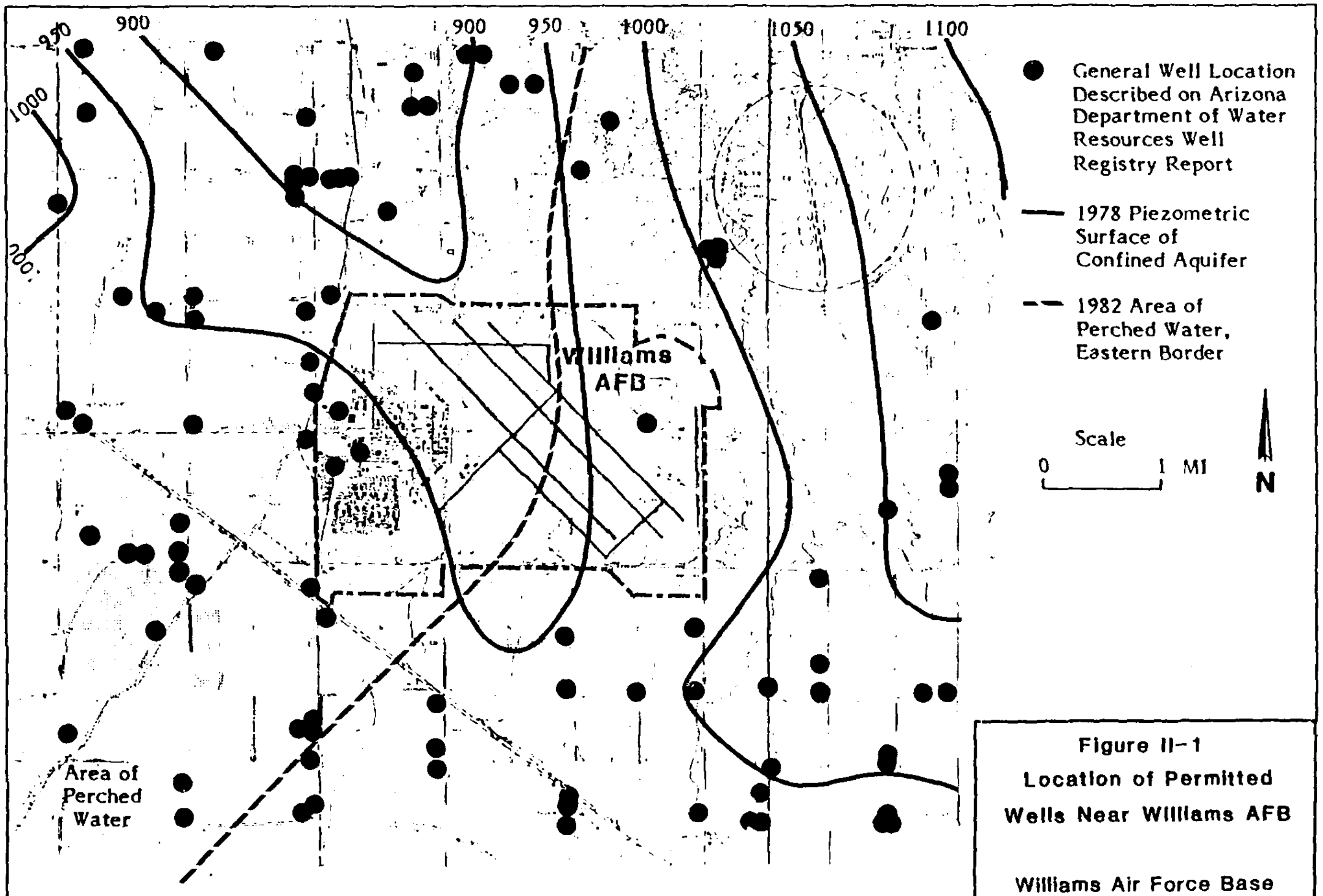
The unconsolidated alluvial deposits in the Salt River Valley are the source for groundwater in the area of the base. These deposits consist of sand, gravel, silt and clay (Arizona Bureau of Mines, 1969).

The water table depicts the upper limit of the saturated geologic materials in the area. The water table was near the land surface prior to development of the groundwater reservoir. The water table during 1976 was about 950 feet MSL at the base or about 400 feet below ground surface. The large reductions in water levels have been the result of pumping water for irrigation and public supply.

Groundwater flowed from east to west in the area of the base prior to development of groundwater for supply (Arizona Bureau of Mines, 1969). Groundwater recharge in the Salt River Valley occurred along the periphery, as underflow or infiltration from surface flow.

Two areas of depressed groundwater levels were evident in 1976 (USGS, 1978). One area occurred approximately four miles south of the base; another in the vicinity of the base extended north for more than ten miles. The depressed water levels are primarily the result of heavy groundwater pumping for irrigation. Regional groundwater flow was toward these areas (see Figure II-1).

A zone of perched water exists under approximately the western half of the base. The perched water probably results from less permeable silts and clays underlying more permeable sandy clays in this area. The perched water level at the base was about 200 feet below land surface in the spring of 1982 (U.S. Geological Survey, 1983). The degree of continuity in the perched water table is unknown (see Figure II-1).



Source: Compiled from Arizona Department of Water Resources Well Registry Report, 1983.

Figure II-1
Location of Permitted Wells Near Williams AFB

Williams Air Force Base

AeroVironment Inc. MONROVIA CA

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C. Site Descriptions

1. Landfill

The landfill, located in the southwest corner of the base, was operated from 1941 to 1976 for disposal of on-base waste materials. The landfill covers approximately 34 acres (see Figure I-2). Filling started in the southwest corner of the site and progressed to the north and east. Both trench and area methods were used. The Air Force reported that the landfill received primarily domestic, office and construction waste, but also took in unknown quantities of hazardous wastes. These hazardous wastes included paint, solvent and oil cans, used rags, unrinsed pesticide containers and other materials.

2. Liquid Fuels Storage Area

The liquid fuels storage area is actively used for storage of jet fuels for the base's training missions. Many above-ground tanks, subsurface tanks and underground pipes are used for fuel storage and transmission. The system used AVGAS fuel from 1941 to 1960 and then changed to the current fuel, JP-4.

The Phase I report identified three spills and one leak at the LFSA. These are shown on Figure I-4. Air Force personnel contacted during Phase II work confirmed the leak and two of the spills reported. No record has been found on the third spill. An old piping system, including subsurface tanks, was sealed and abandoned in 1960. It is not known if this system was drained prior to decommissioning.

3. Fire Protection Training Area No. 2

This area has served as the fire training facility for most of the base's history. It is still used for fire training at Williams AFB. Presently JP-4 is spread on an airplane mock-up, ignited and extinguished.

Until the late 1960's this site burned a large quantity of the combustible liquid wastes generated at Williams AFB. These wastes included fuel, oils, lubricants, cleaning solvents and some paint stripper. Water was extensively used before each fire, possibly minimizing the total impact. However, even with preapplication of water, a quantity of unburned hydrocarbons may have percolated into the ground. Although the current facility has a concrete liner under the fire burn sites to collect residual unburned materials, there was an extensive period of use prior to its installation.

4. Pesticide Burial Site

The pesticide burial site is located near the landfill on the southwest corner of the base. Containers of outdated pesticides were buried in the area from 1968-1972. The Air Force has reported that on four or five occasions during this period, partially filled pesticide containers were buried in separate excavations at the site. One typical burial included five to ten 10-gallon containers and two 55-gallon drums. The exact locations or depths of the excavations were not known at the start of this project.

5. Surface Drainage System, Southwest

The surface drainage system, which transports runoff southwest to the retention pond, has operated since the base was constructed in 1941. It has received plating shop rinsewaters, aircraft washing wastes, and miscellaneous aircraft and vehicle spills from flightline and maintenance operations. The drainage system was used for these wastes until 1959. The system currently drains only storm water, receiving runoff from approximately the southwest quarter of the base.

6. Surface Drainage System, Northwest

The northwest surface drainage system serves a portion of the flightline, golf course, housing, and office areas. The system carries runoff to the northwest and empties into the Roosevelt Canal. This drainage system has served

the base since the early 1940's and has received spills from the flightline, aircraft washing solutions and possibly aircraft stripping and shop wastes. Any disposal of shop wastes in this system probably stopped around 1959.

D. Site Specific Geology

1. Landfill

The soil around the landfill is classified by the United States Department of Agriculture Soil Conservation Service (USDA SCS) as being part of the Gilman-Estrella-Avondale Association. This association of very fine sands, silts, and clayey sands is evident to a depth of 38 to 50 feet in all seven of the test borings completed in this area. Below this association is an essentially planar bed of medium to very coarse sand and gravel. This bed was used as a "marker" bed for all seven test borings. All the holes were deepened until this gravel was encountered, verifying its existence throughout the area. Below the sand and gravel, a sandy, gravelly clay was encounted at 70-80 feet in the four deep borings. The deep holes were placed at the edges of the landfill to check the geometry of the clay bed and verify its existence over the entire area. (Figure IV-1 shows the location of borings around the landfill.)

Near and directly below the landfill, the clay has been shown to be synclinal, dipping gently to the northwest. The axis appears to run generally between holes LA-05 and LA-01, dipping towards LA-01. The synclinal appearance is probably an erosional artifact, since the sediments have probably not been folded. This clay should help retard any leachate generated within the landfill.

No groundwater was encountered in any of the borings. There was no substantial moisture found in either shallow or deep soils, even though several rainstorms occurred the week before drilling at the landfill.

2. Liquid Fuels Storage Area

The soil in the liquid fuels storage area is mapped as being of the Mohall-Continue Association. This soil is slightly less permeable than the surface soil encountered at the landfill and fire protection training area sites (10^{-4} cm/sec versus 10^{-3} cm/sec) due to a higher clay content. A caliche (light cementation) layer was found in all eight holes between eight and nine feet below ground surface. Most of the borings were limited to ten feet in this area, so very little site-specific information was gathered other than surface soil type.

We extended one hole (LI-03) to 45 feet, attempting to determine the lower extent of localized contamination. Medium to coarse sand and gravel were encountered at 38 feet and continued to the final depth of 45 feet. This gravel appeared to be the same material as the "marker gravel" found in all seven landfill borings starting at 35-48 feet. If this was indeed the "marker gravel" it would be safe to assume that there is a laterally continuous gravel bed from about 38 to 70 feet below most of the base. Since the material under the base is essentially alluvial valley fill down to the volcanic bedrock, a planar "layer cake" positioning of the various formations is quite probable.

No groundwater was encountered in any of the borings.

3. Fire Protection Training Area

The soil at the fire protection training area is listed by the Soil Conservation Service as being of the Gilman-Estrella-Avondale Association. As is the case at the landfill, the shallow subsurface (0-15 feet) appears to be closer to the Mohall-Continue Association like the soil at the LFSA. A discontinuous clay or clayey sand layer was encountered in 8 of the 13 borings in the shallow subsurface (0-4 feet). The remaining holes contained fine to very fine sand, much like the landfill. This may be a transition zone from one soil type to another. Caliche was encountered at nine of the test borings starting at 6-12 feet. The caliche is obviously not continuous, either vertically or areally.

There were no borings deeper than 25 feet in this area, so it is not possible either to prove or to disprove the existence of the "marker gravel" at this site.

No groundwater was encountered in any of the borings.

4. Other Areas

The pesticide disposal area, southwest drainage system and northwest drainage system were not investigated sufficiently to gather information on specific geology. No deep borings were required at these sites. Only surface soil samples were collected at the drainage systems and no samples were taken at the pesticide burial site. The pesticide burial site is located very close to the landfill and probably has the same subsurface lithology as the landfill. Problems at these three sites are thought to be limited to surface soils and therefore local geology is not considered important.

E Historic Groundwater Problems

The only obvious historic groundwater problem in the area of Williams AFB has been a drastic lowering of the water table due to overpumping for agricultural and/or municipal uses. This lowering has changed the regional groundwater flow patterns dramatically, tending to concentrate any pollutants in the "pumping depressions" to the north and south of the base (see Figure II-1).

F. Location of Wells

There are three pumping wells on the base at this time. Assuming the water table exists as depicted in previous reports, all the potentially contaminated sites on the base are hydraulically down-gradient from Williams AFB wells.

Williams AFB receives its water supply from deep wells. These wells are referred to as Well No. 5, Well No. 6 and the Ordnance Storage Area Well. Wells 5 and 6 are high-capacity wells located on the west side of the base. The

Ordnance Storage Area Well is a low-capacity well located in the ordnance storage area and used to supply sanitation water to that area. Well 4 is not currently being used for base supply and will be abandoned. The wells vary from 500 to 1,000 feet deep. Well construction data are summarized in Table II-2.

Three wells previously used for water supply have been capped and abandoned. There is no available information on the methods used to decommission these wells. Wells 1, 2, and 3, were located in the housing area. It is probable that the wells could not continue to supply the required water for the base as regional water levels dropped.

Approximately 90 permitted irrigation and domestic supply wells are located within two miles of the installation boundaries. These wells are generally from 200 to 1,200 feet deep. The general locations of these wells are shown in Figure II-1.

Water pumped from wells on the base is of good quality. Water samples taken from base wells between 1977 and 1983 were within primary drinking water standards for those parameters investigated (see Phase I report). Primary standards are required standards for drinking water supplies. Secondary standards address the aesthetic quality of drinking water and on a few occasions they have been exceeded.

G. Meteorology

Two climatic features of interest in determining the potential for movement of contaminants are net precipitation and rainfall intensity. Effective precipitation can be used as an indicator of the potential for leachate generation. It is equal to the difference between annual precipitation and annual lake evaporation. Rainfall intensity is an indicator of the potential for excessive runoff and erosion. The one-year, 24-hour rainfall at the base is approximately 1.5 inches (NOAA, 1966), which is low to moderate in intensity.

Effective precipitation at Williams AFB is -65 inches (more evaporation than precipitation). This value is very low and indicates little probability for

TABLE II-2. Construction summary -- existing wells, Williams Air Force Base.

Well No. 4*	
Total depth	854'
Surface casing 30"	0 to 24'
Blank 20" casing	0 to 294'
Perforated 20" casing	294 to 486'
Reducer 20" to 18"	486 to 492'
Perforated 18" casing	492 to 854'
Well No. 5	
Total depth	1,000'
Surface casing 30"	0 to 25'
Blank 20" casing	0 to 600'
Perforated 20" casing	600 to 1,000'
Well No. 6	
Total depth	1,000'
Surface casing 30"	0 to 24'
Blank 20" casing	0 to 700'
Perforated 20" casing	700 to 1,000'
Ordnance Storage Area Well	
Total depth	500'
Casing diameter	12"

*Well 4 is not now in use and will be abandoned.

No other information available.

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leachate generation at hazardous waste sites on the base (as a result of rainfall). Mean annual precipitation at Williams AFB from 1942 to 1981 was 7.15 inches (Williams AFB documents). Annual lake evaporation for the area is 72 inches (National Oceanic and Atmospheric Administration (NOAA), 1977).

H. Summary of Environmental Setting

The environmental setting data reviewed for the Phase I investigation identified the following points relevant to Williams AFB:

- The soils on the base are moderately permeable, which allows for good infiltration of water to the subsurface. However, effective precipitation, which is rainfall minus evaporation, is -65 inches, indicating that there is little potential for leachate migration at hazardous waste sites resulting from infiltrating rainfall.

- Rainfall intensity and land slope at the base indicate low potential for erosion and transport of surface contaminants from hazardous waste sites. Surface contaminants are primarily transported by erosion of soil particles which have sorbed them (Manahan, 1979). Typical rainfall events at the base are considered low to moderate in intensity. The land slope is 0.4 percent.

- The unconsolidated alluvial deposits at and around the base are the sources for groundwater in the area of the base. This aquifer system consists of a deep water table aquifer that underlies the area and a perched water table aquifer that underlies the western half of the base. At Williams AFB, the deep water table is approximately 400 feet deep. The depth to the perched water table is about 200 feet.

- Flooding potential at the base is minimal. The base lies between the 100-year and 500-year flood plain for streams in the Gila River Basin.

- Numerous wells are located on and around the base. There are three active deep wells on the base. These wells are used for public supply. Wells around the base are generally used for public supply and irrigation.

- The quality of groundwater from wells on the base meets the primary drinking water standards for those parameters measured.

- Deep borings at the landfill and LFSA indicate that a 25 to 30-feet-thick sand and gravel layer may underlie the western half of the base starting at a depth of 35-40 feet. Our drilling at the landfill has shown that this sand and gravel layer overlies a relatively impermeable clay. If this clay is also found below the sand and gravel at the LFSA, it would retard any leachate generated at either site.

III. FIELD PROGRAM

A. Development

1. Presurvey Activities

AeroVironment began work on Williams AFB in May 1984 with the assignment of the presurvey task. During the presurvey, AV studied the recommended field program from previous studies, reviewed available reports, and visited the six sites which had been identified as potentially contaminated. After the presurvey meeting at Williams, the field program was modified to be more cost effective.

AV submitted a presurvey report which summarized the findings and conclusions of the document review and site visit. The report listed the recommended scope of work for the Phase II Stage I survey at Williams AFB. In September 1984, AeroVironment received the work order for the Phase II project. It included all work proposed in the presurvey report. This finalized scope of work is included in Appendix B. Overall, AV was to determine whether contamination existed at the FPTA, LFSA, southwest drainage, landfill and northwest drainage. We were authorized to collect up to 408 samples at those five sites and to conduct a geophysical survey at the pesticide burial site.

2. Sample Plan Development

After receiving the Air Force work order, AV constructed a sample plan for field work at Williams. The objectives of the plan were

(1) To collect soil samples that will prove whether or not contamination exists at a given site

(2) To collect soil samples in such a pattern that some estimation can be made of the extent of contamination

(3) To minimize cost, especially in areas with a low probability of contamination

Soil sampling methods were evaluated for efficiency and sample integrity. Only two alternatives were suitable for collecting soil samples using drill rigs. The most common method uses a split-spoon driver to collect soils at depth. However, the ring sampling method was chosen for use at Williams AFB because of its superior ability to provide reliable samples. (The ring sampling method and its advantages are discussed in Section III D). The hand sampling method chosen uses a hand-held hammer to drive rings in much the same way as does the ring sampling method using a drill rig.

The sampling plan called for collection of as many field samples as practical (within the task order authorizations). After review of site conditions and organic vapor readings, we would make a preliminary selection of samples to be analyzed. Samples to be selected for this first cut would be considered most likely to give positive results, and, therefore, to indicate the presence (or absence) of contamination. This high probability could be due to geologic conditions or waste handling practices at the site. At least one sample from the top and bottom of each hole was to be analyzed with the first cut. After analysis of the first cut of samples, other samples would be analyzed as necessary to define the extent of contamination.

The plan assumed that while we were in the field, it would be more cost effective to collect more samples than would be needed for analysis than to risk the need to return for additional drilling later. However, only high-probability samples would be analyzed, in an attempt to minimize lab costs.

3. Subcontractor Selection

a. Drilling. The original work order called for vertical hollow stem auger drilling at the LFSA and FPTA. Angle drilling was to be completed at the landfill. Angle drilling had been recommended in order to collect soil samples from below the fill material. After contacting drilling firms in the southwestern

United States, AV found that (1) angle drilling is significantly more expensive than vertical drilling (on a per-foot basis) and (2) the nearest qualified drilling firm to Williams AFB is in the Los Angeles area. The additional cost was reviewed in light of the potential for better geologic information and it was decided that the cost-benefit ratio of angle drilling was too unfavorable to justify its use. USAF OEHL agreed and the requirement for angle drilling at the landfill was eliminated from the task order. Drilling through fill material is never allowed under current OEHL policy.

On August 3, requests for bids (RFB) were sent to four drilling firms:

- California Testing Company of Long Beach, California
- Heber Mining and Exploration Company of Phoenix, Arizona
- Sergent Hauskins and Beckwith Inc. of Phoenix, Arizona, and
- Western Technologies Inc. of Phoenix, Arizona

Bids were received from all four firms by August 15, 1984. The RFB asked for a per-hour rate for drilling, grouting and delay time, grout, drums and sampling rings. All decontamination, travel, set-up and equipment costs were bid as a lump sum. The RFB originally requested bids for split-spoon sampling and stainless steel sampling rings. The steel ring stipulation was later modified to allow for brass rings on the majority of the samples.

Bids from the four firms were evaluated for cost and demonstration of ability to perform the work. Sergent Hauskins and Beckwith was unable to meet the schedule and was removed from consideration. California Testing was not cost-competitive due to their location (California Testing was originally contacted because of their angle drilling capability). The other two bids were evaluated, and Heber Mining and Exploration was selected based on (1) past experience at Williams AFB, (2) proposal of a more efficient barrel sampler, and (3) a slightly lower estimated cost. Heber was selected to provide drilling and sampling using a core barrel ring sampler. Heber would also supply brass rings for samples taken at the landfill, LFSA and FPTA, and stainless steel rings for the southwest drainage channel.

b. Geophysical Study. The Phase II work order called for a geophysical study at the pesticide disposal area. The method to be used would be selected to best achieve the objective, which was to identify buried containers within the established boundaries of the pesticide area. On August 7, requests for proposals were sent to

- Woodward-Clyde Inc. of Santa Ana, California
- Earth Technologies Inc. (Ertec) of Long Beach, California, and
- Mr. David Dietz, associated with the University of Arizona in Tucson, Arizona

Three proposals were received and evaluated. Mr. Dietz proposed a magnetometer survey. Woodward Clyde proposed an electrical conductivity survey. Ertec proposed both magnetometer and conductivity studies. We decided that a magnetometer survey would be the least expensive, if it revealed the locations of the cans or drums under the conditions prevailing at Williams. Based on this decision and a comparison of costs (technical approaches were similar), Mr. Dietz was selected to perform a magnetometer survey at the pesticide burial area. We decided that a conductivity survey would also be performed if the magnetometer results were inconclusive. Woodward-Clyde would do the conductivity survey, if needed.

c. Safety Plan. AeroVironment and Air Force policy require that an appropriate health and safety plan be prepared before field activities can begin. Safety concerns related to this field work focused on the hazardous nature of some chemicals suspected of being present at the site, as well as the "unknowns" relative to exact location, concentration and volume of possible contaminants. In addition, digging through contaminated areas increases the potential for airborne release of chemicals. Also, with the use of machinery comes the potential for mechanical injury.

The site safety plan used by AV's field team is included as Appendix K. The plan required that all field personnel wear standard work outfits (steel-toed boots, hardhats, etc.). The plan also required that the air at all sites be monitored for organic vapors, oxygen deficiency and explosive gases.

Work at the landfill, LFSA, and FPTA consisted of soil drilling and sample collecting. These activities bring previously isolated and potentially contaminated soils to the surface. The potential for skin exposure or inhalation is significant. Work at the drainage channels required collection and logging of surface soil samples. To collect these samples, field personnel came into direct contact with the potentially contaminated soils under study. Work at the pesticide area, however, was not intrusive and therefore not considered to be a safety concern. All work areas were in the open, out of doors, with good air circulation.

Special safety measures were necessary around the liquid fuels storage area because of JP-4 storage activities. The field team coordinated with Air Force fire and safety personnel prior to drilling in that area. Final safety requirements at the LFSA included using spark arrestors, grounding wires and explosive gas monitors and having fire fighting equipment at the site during drilling.

When handling uncontaminated samples, workers wore latex gloves to keep skin clean. While handling samples thought to be contaminated, they wore coveralls and 14" neoprene gloves over the latex gloves.

The ambient air was monitored to alert the field team should breathing zone concentrations rise above acceptable levels. At Williams AFB, the following action levels were set up for organic vapor meter readings:

0-5 pm (above background):	no respiratory protection
5-50 ppm:	air purifying respirator with organic chemical cartridge
50 - 2,000 ppm:	self-contained breathing apparatus
2,000 ppm and above:	no work

Other criteria were set for oxygen deficiency and explosive gases.

Air Force personnel at Williams AFB were aware of all activities each day. Emergency services (fire, police and hospital) were available on-base.

B. Implementation of Field Program

1. Drilling Phase

The majority of the field work at Williams AFB involved collecting soil samples from below the ground surface. Heber Mining and Exploration Company of Phoenix, Arizona, provided a CME 55 truck-mounted drilling rig. Heber personnel operated the rig and were responsible for collecting samples at the specified depths. The drilling crew consisted of a driller and a helper.

AeroVironment was responsible for selecting sample locations, logging samples, and sites. AV's field geologist worked with the drilling crew to ensure that proper collection techniques were followed. After samples were brought to the surface, the geologist logged the samples and sealed them for storage and shipment. The drilling crew was then responsible for decontaminating the sampling mechanism. After reviewing the geologic log for each hole drilled and others nearby, the geologist instructed the drilling crew regarding any additional samples to be taken. The field geologist was also responsible for ambient air monitoring and measuring organic vapors from the soil samples and cuttings brought to the surface.

AV's field project manager remained behind the safety line, at the command post, as much as possible. The field manager was responsible for documenting activities, logging sample numbers, preparing samples for shipment, and ensuring site safety and the progress of drilling activities. Because of the potential for contamination of both samples and personnel, the number of people working in the contaminated area (informally defined as the drill rig and immediate vicinity) was kept to a minimum.

The geologist was the only person who handled the soil samples before they were capped. Marking and capping were done immediately after the sampling mechanism was opened. The geologist wore latex gloves to minimize the chance of skin or sample contamination.

A five-foot-core barrel device was used for collecting soil samples. The barrel was lined with thin-wall, six-inch brass tubing and then "pushed" through the soil with the drill rig. The barrel was then removed from the bore hole, and rings from the desired depths were collected and processed. The sampling procedure is described in more detail in Section III-D. A diagram of the sampling mechanism is shown in Figure III-1.

The brass rings used to collect samples were always new, therefore there was no need to decontaminate them (see Section III-E for a discussion of sampling reliability). A lint-free tissue was run through the assembled sampler before each run to remove dust or moisture from the inside of the rings. Rings were sometimes reused as spacers within the five foot barrel, but these reused rings were washed and rinsed before reuse.

The sample barrel and "shoe" (end piece) were decontaminated with a soap and water wash and drinking quality water rinse between each run. The augers were decontaminated after each use with a high pressure steam wash using drinking quality water.

Cuttings from the bore holes were generally spread out near the boring. Cuttings from borings LI-03, FP-08, FP-09 and FP-15 were drummed and stored, pending results from laboratory testing. All other waste material generated during drilling activities, including gloves and coveralls, were bagged and placed in on-base trash receptacles.

2. Hand Augering Phase

The hand augering and sampling was organized less formally than the drilling acitivities. Only two individuals carried out this work, AV's field

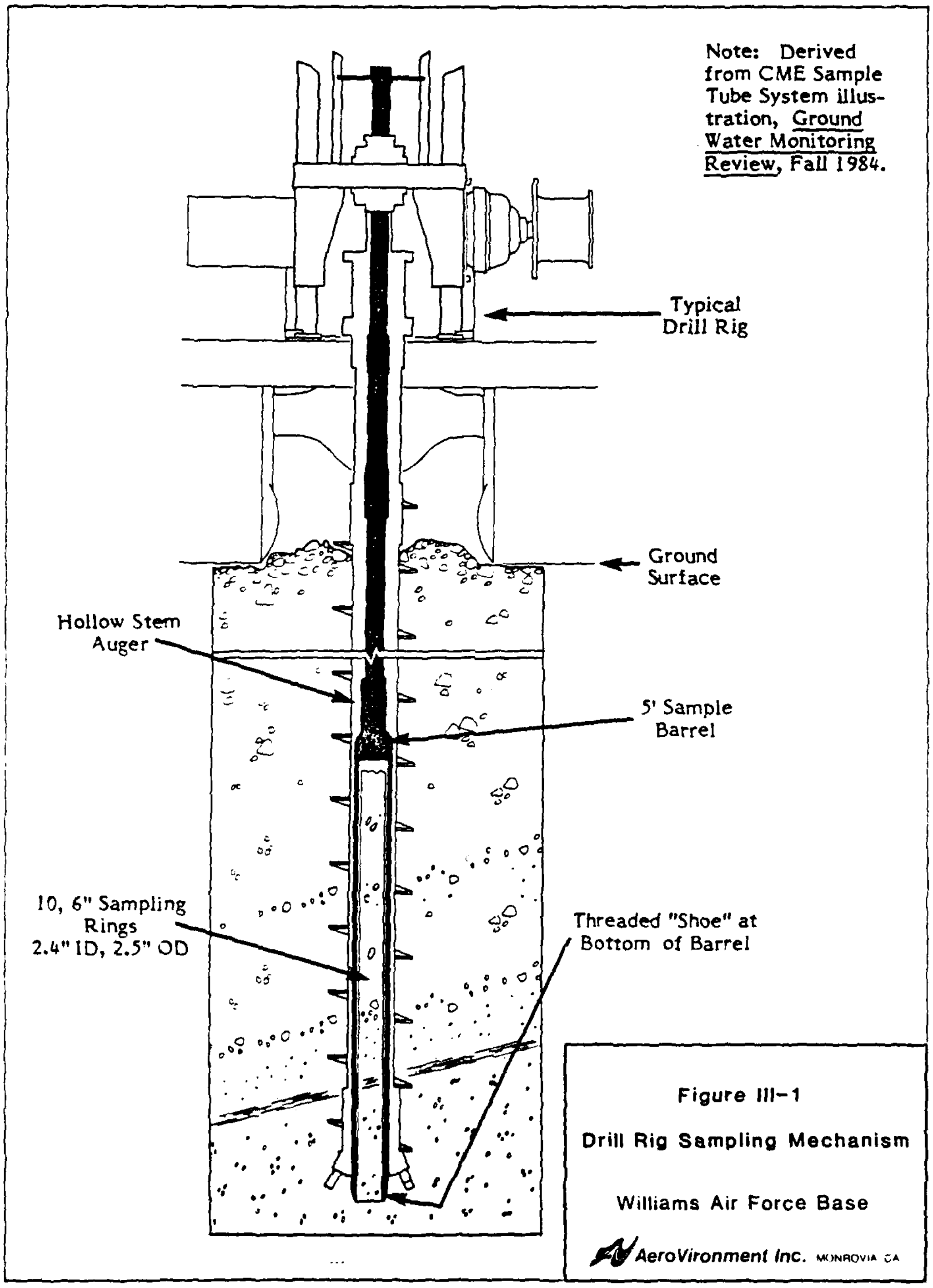

Figure III-1

Drill Rig Sampling Mechanism

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geologist and field project manager. No formal safety line was established, nor were work assignments specific. One team member drove the sampler to collect samples and the other augered the hole to collect the deeper sample. Sample handling, documentation, and decontamination were done by either team member. They always wore latex gloves when handling samples.

The sampling method is described in greater detail in Section III-D, but consisted of pounding a steel ring through the soil. The soil was collected in the ring, capped, and sealed. The work order called for collecting soil samples at the ground surface and at 4 feet. After attempts to dig to 4 feet at the first sampling location, we found it necessary to modify the sample collection criteria to reflect actual field conditions. A layer of soft sediment, usually about 1-2 feet deep was found to overlie both drainage channels. Under that layer is a very hard, dry, well-packed soil which was not easily penetrated. It was decided that a surface sample would be taken, then the hole advanced to the hard soil. The second sample was taken at that depth, giving a sample of the top 6 inches of the hard soil. The extent of the soft soil layer appeared to be influenced by the amount of moisture in the soil. At the time of the sampling program the soil was relatively wet because of recent rainfall.

Only small amounts of waste soil were generated during the sampling. This soil was spread out in the area of the sample hole.

3. Magnetometer Phase

The limits of the pesticide burial site are unknown. The best guess is that the site is bounded by the metal warning signs placed in the area. The magnetometer crew set up a 120-foot-by-140-foot grid system which extended approximately 30 feet past the signs to the north, south, and east, and over 50 feet to the west. The grid system is shown in Figure III-2. No equipment, other than the magnetometer, was used for this study. All vehicles were kept out of the area to avoid metallic interference.

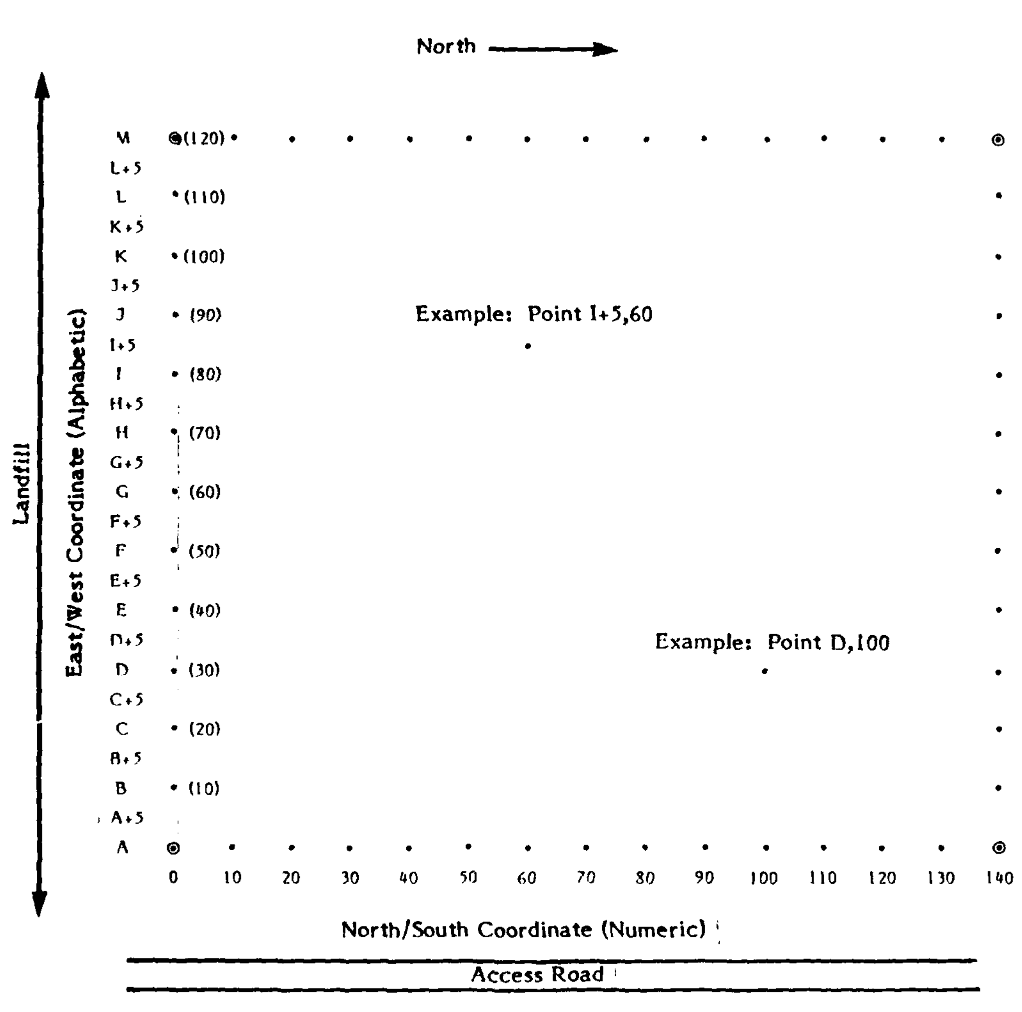

Figure III-2
Grid System of Magnetometer Survey at Pesticide Burial Area

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The magnetometer crew consisted of two University of Arizona graduate students. One operated the instrument, the other recorded data. Duplicate magnetometer readings (at a minimum) were taken at five-foot intervals over the entire grid. Data were collected along north-south lines, moving east to west.

Measurements of both the earth's magnetic field and the induced magnetic field of any anomalous metallic bodies were taken with a Geometrics Model G816 proton magnetometer. Each measurement consisted of at least two magnetometer readings which were within acceptable limits of agreement. A field base station was established at the beginning of each day, and base station measurements were retaken after two north-south traverses. The base station readings measured the diurnal variation of the magnetic field.

The magnetometer survey was completed twice. Because the first survey was hampered by interference from the metallic signs, the signs were removed and a second survey performed. The second survey produced results nearly identical to the first, with the exclusion of the sign interference.

The data were reduced using established computer algorithms at the University of Arizona's Department of Geosciences. University of Arizona program MAKE1.FIL followed by MAKE.FIL were used to reduce the data set. The computer provided isopleth maps of the total magnetic strength measured at each location. Data manipulations were also performed manually.

4. Laboratory Interface

All samples collected at Williams AFB were analyzed at Acurex Corporation. A major objective of the field program was to provide the analytical results necessary for decision making, but to minimize as much as possible the analysis of insignificant samples (and the resulting high laboratory costs). To meet this objective, field and laboratory personnel remained in close contact throughout the field program, and, in addition to normal chain-of-custody forms, sample analysis tracking forms were filled out by field personnel and shipped with the

samples. These tracking forms (Figure III-3) were used to target the highest priority samples for the laboratory. USAF OEHL was shipped a duplicate soil sample from most sampling locations. Air Force Forms 2752 were completed for each sample. A comparison of AV sample codes and Air Force sample numbers is made in Appendix C.

Formal decision criteria were set up so that those samples which were most likely to be contaminated, based on available information prior to field work, would be analyzed in a first cut. The other samples which were collected in the field would be analyzed only as dictated by results from the first analyses. A total of 272 soil samples were collected in the field. Only 155 were targeted for initial analysis.

The following general guidelines were used for selection of initial analyses:

Quality assurance samples	-	Analyze both the original and duplicate
Southwest Drainage Channel	-	Analyze all samples
Northwest Drainage Channel	-	Analyze all samples
Landfill	-	Analyze every third sample, starting with No. 3
FPTA	-	Analyze the top three samples and the bottom sample
LFSA, leaks	-	Analyze the bottom three and a middle sample
LFSA, spills	-	Analyze the top three samples and a bottom sample

Some field conditions dictated changes to the above guidelines, particularly at the FPTA, LFSA and landfill. However, no data gaps were created by these variations.

Based on the results of the initial sample analyses, additional samples (if any) in a given hole were selected for analysis. The following decision steps were used:

LOCATION: FIRE PROTECTION   HOLE: FP- 00

SAMPLE ANALYSIS TRACKING FORM

SAMPLE NO.	DETECTION LIMIT / DEPTH	5 TOX	50 O&G	1 PHENL	2 Pb	Cr	Cd		
FP- 00-01	0.5-1.0	ND	70	ND	40				
-02	1.5-2.0′	ND	100	ND	70				
-03	3.0-3.5′	ND	300	ND	63				
-04	4.5-5.0′		•		•				
-05	6.0-6.5′		•						
-06	7.5-8.0′		•	•					
-07	9.5-10′	ND	250	7	ND				
		NO CONTAMINATION INDICATED	ANALYZE ALL REMAINING SAMPLES	ANALYZE [illegible] FROM SAMPLE [illegible]	ANALYZE LEAD FROM SAMPLE 03				

• 2ND STEP ANALYSIS

↘ 3RD STEP ANALYSIS

AV-F-HW03

Figure III-3
Sample Analysis Tracking Form

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- Calculate the average concentration of each parameter in the background hole at a site.

- Define a positive result on any analysis (each analyte on each sample) as a concentration greater than 1.3 times the background mean plus one standard deviation of the background.

- Conduct additional testing on any samples collected near "positive results" samples from the first cut. Analyze for only those parameters which were positive on the first cut.

This method was used successfully to determine fully the bounds of contamination (to the extent possible based on collected samples) without complete analysis of all samples. Only 190 of the 272 soil samples collected were ultimately analyzed. Table III-1 shows a breakdown of the number of samples collected at each site, and the numbers analyzed in the first and second cuts.

5. Daily Activities

a. Monday, September 24, 1984. The field crew attended an introductory and safety meeting at the base hospital conference room.

Drilling and soil sampling operations started in the fire protection training area. The initial boring was FP-14, the background hole. This approach allowed collection of the least contaminated samples first. The remainder of the day was spent boring FP-03 and FP-04 (FP-01 and FP-02 will be hand borings completed later in the program). Twenty samples were collected and 34.5 feet drilled.

b. Tuesday, September 25, 1984. The crew completed holes FP-05, FP-06, FP-07, FP-08 and started FP-09. A strong odor and elevated OVM (organic vapor meter) readings were noted from the open borehole at FP-08. OVM readings in the breathing zone at FP-08 were acceptable for work without respiratory protection. During the drilling of FP-09, however, the ambient air

TABLE III-1. Final laboratory analyses.

Site	Parameters	Samples Collected	Samples Analyzed First Cut	Samples Analyzed Second Cut
Southwest Drainage Channel	TOX, O&G, Phenol, MEK, Pb, Cr, Cd, Cu, CN^-	14	14	0
Northwest Drainage Channel	TOX, O&G Phenol, Pb MEK	8	8	0
Fire Protection Training Area	TOX	96	68	5
	O&G	96	68	11
	Phenol	96	68	5
	Pb	96	68	4
Liquid Fuels Storage Area	TOX	51	36	3
	O&G	51	36	4
	Phenol	51	36	6
	Pb	51	36	3
Landfill	TOX	103	38	4
	O&G	103	38	6
	Phenol	103	38	6
	Pb	103	38	15
	Cr	103	38	18
	Cd	103	38	6
Waste	E.P. TOX and Ignitability	4	4	0

TOX - Total Organic Halogens
O&G - Oil and Grease
MEK - Methyl Ethyl Ketone
Pb - Lead
Cr - Chromium
Cd - Cadmium
Cu - Copper
CN^- - Cyanide

downwind from the hole became too contaminated to allow sample inspection without respiratory protection. An air purifying respirator was used by the field geologist. In an effort to reach the bottom of the contaminated soil, the drilling crew advanced the boring to a depth of 20 feet before stopping for the day. Cuttings from FP-09 were drummed.

Thirty-seven samples were collected and 69 feet drilled.

In addition to the drilling, a magnetometer survey was conducted at the pesticide burial area. A grid of 140-feet-by-120-feet was set up and readings were taken at 5-foot intervals. The survey was hindered by the presence of three large iron warning signs at the site. These signs created a large magnetic anomaly in the center of the survey grid which would have masked any buried drums in the area.

c. Wednesday, September 26, 1984. Augers were steam cleaned. Because of thunderstorms with lightning, no drilling was done.

d. Thursday, September 27, 1984. Borings FP-10, FP-11, FP-12, FP-13 and FP-15 were drilled and FP-04 was completed down to 25 feet (initial 20 feet of FP-09 was drilled on September 25).

Members of the drilling crew were fit tested and instructed in the use of respirators before drilling FP-15. Respirators were used for most of the work at FP-15 and throughout the completion of FP-09. Cuttings from FP-08, FP-09 and FP-15 were placed into drums for holding, pending testing.

Thirty-four samples were collected and 60 feet drilled.

e. Friday, September 28, 1984. All fire protection training area holes were grouted to ground surface. The crew wore respirators to grout FP-08, FP-09, FP-13, and FP-15.

We moved the drill rig to the liquid fuels storage area after meeting with base personnel about restrictions and upgraded safety measures. Borings LI-09 (background), LI-01, and LI-02 were drilled.

Eighteen samples were collected and 30 feet drilled.

f. Monday, October 1, 1984. Due to scheduling problems at the liquid fuels storage area, the drill rig was moved to the landfill area to drill the background hole at that site (LA-07). This hole was terminated at 80 feet in a gravelly clay layer. Directly above this clay was a distinctive zone of coarse sand and gravel, which extended from 39 feet to 70 feet. The sand and gravel layer was later used as a "marker" zone for all the borings in the landfill area. Drilling was terminated in mid-afternoon due to extremely windy conditions.

Eighteen samples were collected and 80 feet drilled.

g. Tuesday, October 2, 1984. The field team returned to the liquid fuels storage area and began drilling within the fenced area around Building 548. The first hole (LI-03) was advanced to a depth of 45 feet in an effort to find the vertical extent of contamination. The geologist wore a respirator while segregating samples. The respirator was required because high levels of organics were given off as samples were removed from the core tube. Later, holes LI-04, LI-05, LI-06, and LI-07 were drilled without any safety problems. Air Force fire trucks were on standby at the site throughout the day.

Thirty-three samples were collected and 84.5 feet drilled.

h. Wednesday, October 3, 1984. The field crew moved the drill rig to the landfill area and advanced boring LA-01 to 60 feet. In the afternoon, all holes at the liquid fuel storage area were grouted to the ground surface.

Twelve samples were collecteo and 60 feet drilled.

i. Thursday, October 4, 1984. The crew extended boring LA-01 down to clay at 80 feet (from 60 feet where drilling stopped on October 3, 1984). LA-02 and LA-03 were also completed. Air Force personnel removed the metal signs from the pesticide burial area.

Thirty-one samples were collected and 114 feet drilled.

j. Friday, October 5, 1984. Boring LA-04 was completed through the "marker gravel" and down to the underlying clay at 80 feet. Due to problems with the drill rig, the drillers were able to extend LA-05 to only 55 feet. At the end of the day, the hole was reamed and the augers left in the ground for the weekend.

Twenty-five samples were collected and 136 feet drilled.

k. Monday, October 8, 1984. Hole LA-05 was drilled from 55 feet to a final depth of 83.5 feet. Boring LA-06 was then completed to the "marker gravel." This completed the drilling portion of the field program. The drilling rig and tools were given a final decontamination.

Seventeen samples were collected and 78 feet drilled.

l. Tuesday, October 9, 1984. All the landfill holes were grouted to ground surface. AV personnel began shallow hand borings in the southwest drainage channel, completing holes SW-01, SW-02, and SW-03.

Seven samples were collected.

m. Wednesday, October 10, 1984. Sampling in southwest drainage was completed with SW-04, SW-05 and SW-06. The field team then sampled FP-01 and FP-02 in the fire protection training area and collected shallow boring samples NW-01, NW-02, NW-03, and NW-04 in the northwest drainage. Late in the day, samples were collected from the four drums of drill cuttings (cuttings from the fire protection training area and the liquid fuels storage area). Because of

possible hazardous vapors from the opened drum, respirators were worn during this sampling.

Twenty-three samples were collected.

n. Thursday, October 11, 1984. All hand borings were grouted to the ground surface and a second magnetometer survey was conducted at the pesticide burial area (without the metal signs on site). The original survey had shown several potential burial sites, but the metal signs had imposed a "shadow" on the readings. Concrete markers were placed at the four corners of the pesticide area grid.

C. Field Instruments

The field work at Williams AFB did not require extensive instrumentation. The work was reasonably simple, accomplished mostly by mechanical means, without the need for highly technical procedures. Because AV was required to collect only soil samples on this project, an organic vapor meter (OVM) was the only instrument used during the sampling program. The OVM was used for monitoring personal safety and taking qualitative measurements of volatile organic contamination in samples. A magnetometer was used for locating buried metallic material at the pesticide burial area.

The organic vapor meter used during the Williams program was an Analytical Instrument Development (AID) model 590 OVM. The 590 is a photoionization instrument which uses a high energy, ultra-violet radiation source to ionize a small portion of the sample, which is introduced into the ionizing chamber. Ionization is initiated by the adsorption of the high energy photon by a molecule of vapor in the ionization chamber. If the molecule has an ionization potential equal to or less than the photon energy (hV), the molecule is ionized, forming a positive ion and an electron: $R + hV = R^+ + e^-$. This ion formation occurs in an electrical field between the collector electrode and the jet in the detector ionization chamber. Ions and electrons that reach the electrodes contribute to a small ionization current that is measured with the electrometer of the instrument.

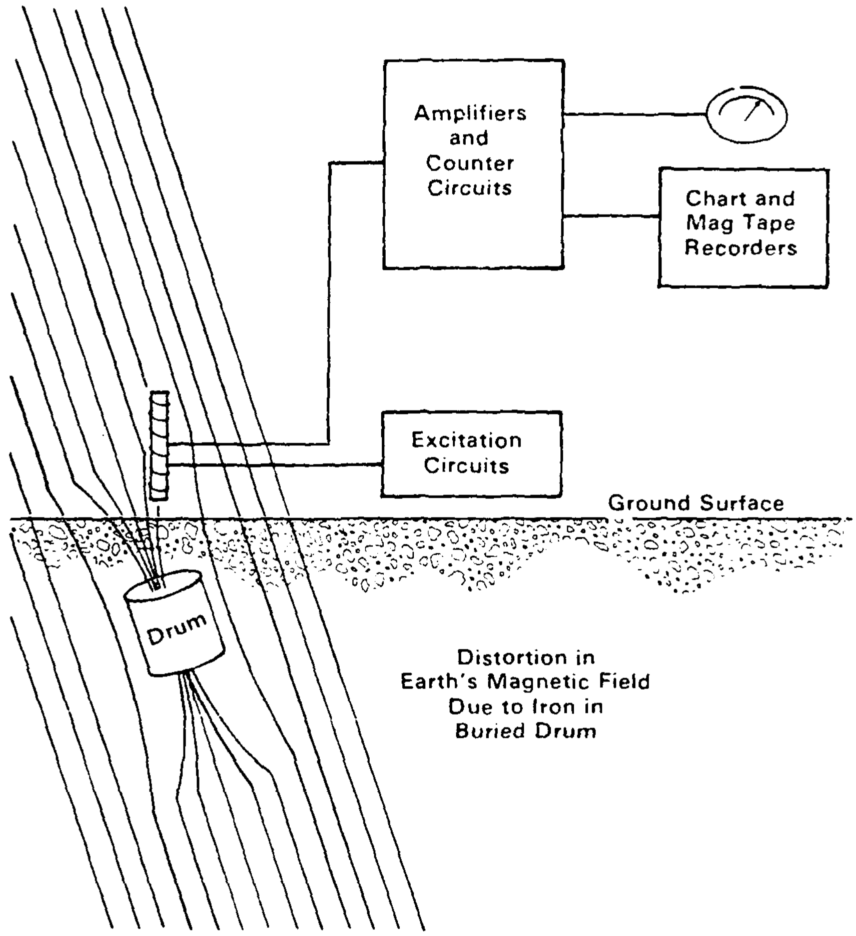
The number of ions that reach the electrodes will be proportional at any given time to the concentration of the ionizable molecules within the detector, provided the linear range has not been exceeded. The instrument used during the project has a 10.0 electron volt energy level, which does not detect methane or other very light organic compounds. The OVM was checked and zeroed at the beginning of each field day.

The magnetometer used by the University of Arizona team was a Geometrics model 6816 proton magnetometer. Magnetometers are used to detect perturbations in the geomagnetic field created by buried ferromagnetic objects, such as steel containers or drums, tools, or scrap metal. An induced magnetization is produced in any magnetic material within the earth's magnetic field, and this induced field is superimposed on the geomagnetic field. If strong enough, this induced field produces a localized anomaly in the geomagnetic field. Figure III-4 is a schematic of a simple magnetometer. The Geometrics 616 is capable of producing direct readings of total gamma at about 20 second intervals. Zeroing checks were made at regular intervals throughout the magnetometer surveys.

D. Sampling Procedures

The soil sampling at Williams AFB was broken into two parts. Part I sampling used a truck-mounted CME 55 drill with a 3-1/4-inch inner diameter (I.D.), 6-5/8-inch outer diameter (O.D.) hollow stem auger for the 28 deep borings (10 to 83 feet); Part II sampling used a hand auger for the twelve shallow borings (to 3.5 feet).

During Part I sampling, AV used a continuous sampling system (see Figure III-1). With this system, the 5-foot sampling barrel was placed inside the lead auger of a hollow auger column, extending a short distance in front of the auger head. This arrangement allowed sampling to occur with the advance of the augers. Before and after use, the sample barrel was split down the middle and ten 6-inch, thin-walled brass sample-retaining cylinders were used as liners. During augering, soil was pushed up into the liners, allowing sample to collect only on the clean liner. Brass cylinders could be used on this project because samples collected



Source: U.S. EPA EMSL, 1982.

Figure III-4

Diagram of Magnetometer System

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in this phase would not be tested for copper. The cost of brass is substantially lower than other available materials.

Using this system, drillers were able to collect an essentially undisturbed core and the most representative sample(s) of the 5-foot run were chosen for laboratory analysis. This method also provided the flexibility to collect extra samples out of the 5-foot core, if conditions warranted. As each 5-foot core barrel was opened, the brass cylinders were marked with their appropriate depths, and samples were chosen for laboratory work. The appropriate 6-inch sample cylinder was removed from the core barrel and the open ends were immediately covered with aluminum foil, capped with airtight plastic caps and further sealed around the cap edges with electrical tape. The soils in the rings were inspected and recorded in the geologic logging of the boring. This method provided an undisturbed, airtight sample to be shipped to the lab in its collection cylinder. After the sample was sealed, it was labeled and stored on ice in the same cooler it was to be shipped in.

The AV field team considers the "ring sampling" method used at Williams AFB to be superior to the traditional split-spoon sampling method used on most EPA drilling programs. Split spoons require reusing the sampler, opening and mixing the soil sample, and transfering the sample into the sample jar. The ring method virtually eliminates the sampling errors of cross-contamination, sample mishandling, and loss of volatile compounds.

In addition to providing undisturbed samples, the ring sampling method allowed us to prepare a continuous lithologic log of each hole, without segments of the log where "educated guesswork" was needed.

Most samples were taken in pairs, with the top cylinder of the pair going to AeroVironment's lab (Acurex) and the lower cylinder sent to the OEHL laboratory at Brooks AFB, Texas. Thus, the Air Force sample is not a "split" in the strict sense, but an undisturbed sample from the following six inches of formation. Quality assurance (QA) samples, taken for Acurex laboratory checks, were also taken from immediately adjacent cylinders. Like the OEHL sample, QA samples

were not true splits. QA samples were always taken from the 6-inch sample directly above the regular sample, with the OEHL sample directly below the regular sample (Section III-E discusses the correlation of QA samples).

The sampler was washed with Alconox detergent and water, rinsed with drinking quality water, and reloaded with new cylinders between each 5-foot sampling run. The drilling tools were steam cleaned between holes to avoid cross contamination. All holes were grouted to the surface with cement at the end of drilling in each area.

In Part II, hand-augered samples were obtained in much the same way as regular drive samples. The sampler (Figure III-5) held a single 6-inch cylinder, 2.0 inches in I.D., and was driven into the soil with a slide-hammer attachment. The sample collection cylinder was machined from stainless steel, or mild steel, depending on the application. Stainless was used in the southwest drainage because the samples were being analyzed for metals. Mild steel was used in the other areas where potential contamination from the cylinder was not a problem. After a sample was collected, it was removed from the sampler in its collection ring, the ends were covered with aluminum foil, capped, taped and logged, just as for the deep samples. The sampler was washed with Alconox and water and rinsed with drinking quality water between samples. After the surface sample was taken, the boring was advanced to the desired depth with a hand auger and the soil sampler was again used to obtain a 6-inch core at the bottom of the hole. The hand auger was cleaned between each hole.

The method of collecting shallow soil samples in undisturbed rings is considered by AV team members to be significantly better than more traditional methods. The traditional method involves excavating the soil, mixing it, and placing it into sample containers. This method provides multiple opportunities for loss of volatile constituents or addition of outside materials into the soil. The method used at Williams AFB reduced the potential for sampling error.

Because the shallow samples in this phase were depth-specific, the splits for the Air Force were taken in a separate hole immediately adjacent to the

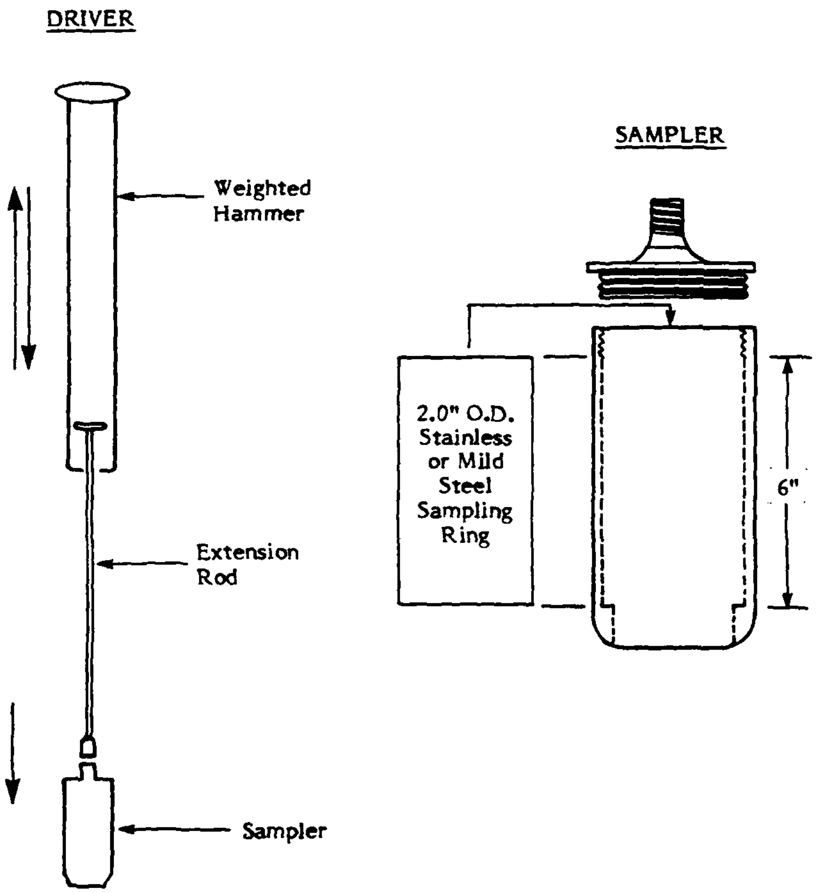

Figure III-5
Hand Sampling Device

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original hole. This allowed the OEHL samples to be taken at the same depths as those taken for the AV's lab (Acurex). When QA samples were taken, a third hole was made, parallel to the other two. All hand borings were filled with concrete at the end of the sampling operations.

A background boring was made at each of the five sites which were sampled. Background borings (deep or shallow) were always taken in an area near the site to be investigated, but away from the influence of the potential contamination. Samples were taken from similar depths in both background and on-site holes.

Drum samples were collected from the cuttings of the most contaminated borings which had been containerized pending testing. The method used was the established method for sampling loose solids. The drums were opened and the material in the center of the drum was mixed to a depth of 6-9 inches with a disposable plastic scoop. The sample was then taken from the mixed pile with the scoop and placed into the glass sample jar. The scoop was left in the drum and the drum resealed.

E. Reliability of Sampling

The methods used in the Williams AFB field program are considered to be the best available for collecting undisturbed samples. By collecting the soil in the ring, the soil was left in the same physical and chemical condition as it was insitu. The material was not exposed to the atmosphere and thus to potential loss (or addition) of volatile chemicals. Only the ends of the soil sample (contained in the sample ring) were exposed, and these were removed in the laboratory prior to sample preparation.

The ring sampling method virtually eliminated human contact with the sample, reducing the risk of contamination by gloves, equipment, or other samples. The only surfaces the soil contacted were the caps and the cylinder surfaces. There is always a potential that the sample containers used in the sampling program could have dirt on their inside surfaces, even though they are new. To

assure that no contamination of samples occurred from the cylinders used in this program, a lint-free tissue was run through the sample barrel before each use to remove any dirt on the inside. More importantly, the portions of the sample contacting the cylinder or cap were discarded by the laboratory. The inner portion of the core was left totally undisturbed and was the only part of the sample used for laboratory analysis. Review of sample analysis results shows that many samples had no detectable concentration of any analytes. This indicates that there is no detectable contamination of any of the samples from the sample cylinder (all cylinders cut and handled in the same way).

The results of laboratory analysis correlate very well with observed field conditions. Samples which were found to be stained or to give high organic vapor readings in the field were later found to be the samples most highly contaminated.

The results of the field and laboratory QA programs were very good. Comparison of field QA samples and adjacent soil samples (within 6 inches) showed close correlation. The results should not be expected to be identical because true splits were not collected. The method of soil sample collection did not permit true splits, but increased the reliability of overall sampling by reducing potential sampling error (loss or addition of compounds). There is no indication of sample contamination from sampling methods or materials. The data analysis tables in Section IV-A illustrate the repeatability of these QA samples. Laboratory QA program results, discussed further in Appendix E, were all considered very good.

All samples shipped from the field were received by the laboratory under chain-of-custody and in proper condition. All samples were received within 24 hours of shipment. Copies of all chain-of-custody forms are included as Appendix F.

IV. DISCUSSION OF RESULTS AND SIGNIFICANCE OF FINDINGS

A. Discussion of Results

Based on the results of the Phase I and Phase II studies at Williams AFB, the following information was derived.

1. Geology

The soils at Williams AFB are remarkably similar over all the sites studied. The USDA Soil Conservation Service has shown that two main soil associations, Mohall-Continue and Gilman-Estrella-Avondale Association, cover the base. These soils differ primarily in clay content, with the Mohall-Continue having a 5-10% greater clay content with an equally lesser fine sand content in the upper layers. The soil permeability over the base ranges from good to poor (10^{-3} to 10^{-4} cm/sec), depending on clay content.

The soil found at our study sites showed this variability quite well. The LFSA in approximately the middle of the base had soil with poor permeability and a definite clayey layer at or near the surface. The landfill area soil had a greater percentage of sand than the FPTA soil and good permeability. At the FPTA, soils of each type were found, indicating that this area may be a transition zone between soil types. Infiltration at the FPTA is hindered by an old, cracked and broken asphalt surface that covers the site.

Our best information on the geology below the soil zone on base was obtained during our drilling at the landfill. Four of these borings were extended down to approximately 80 feet (see Figures IV-1 through IV-5). These borings showed three distinct, essentially flat, planar units in a "layer cake" configuration. This "layer cake" configuration is typical of the central areas of alluvial basins (Ariz. Bureau of Mines, Bull. 180). The upper unit consisted of very fine to medium sands and silt down to 35-40 ft. The fine sands and silts of the surficial soil associations (Mohall and Gilman) were very similar to this upper unit. However, the unit had less clay and was generally coarser grained than either of

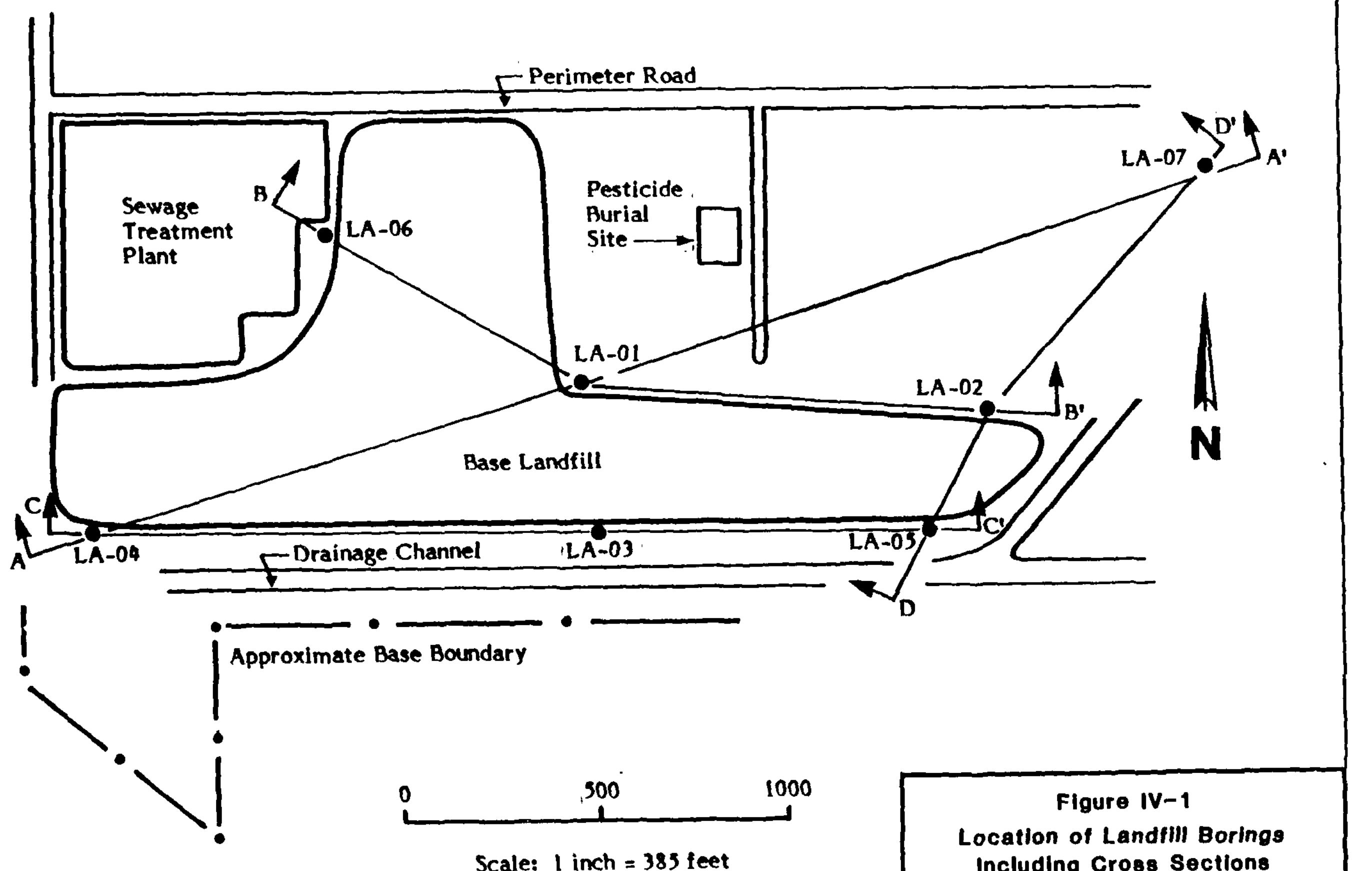

Figure IV-1
Location of Landfill Borings Including Cross Sections

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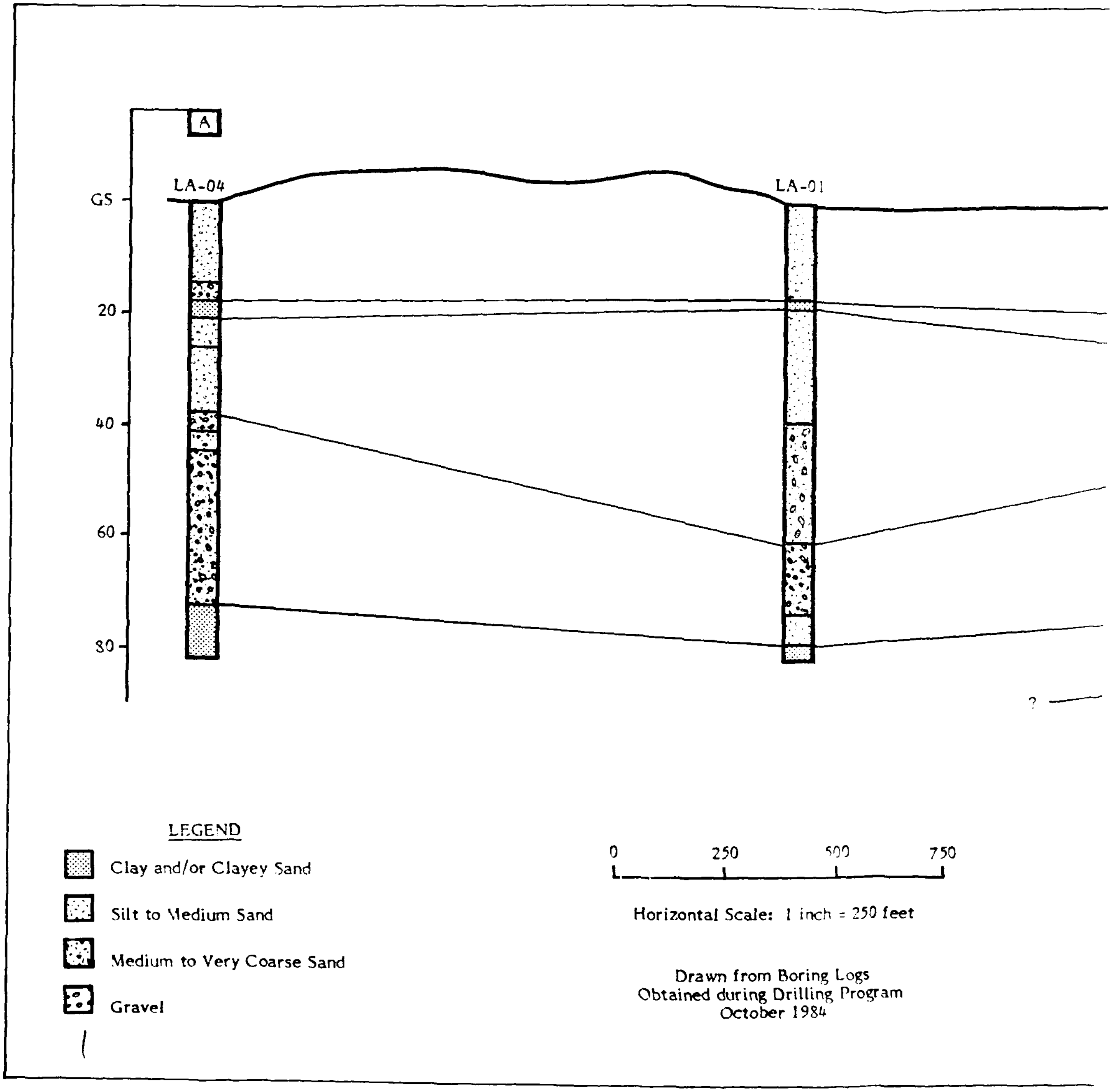
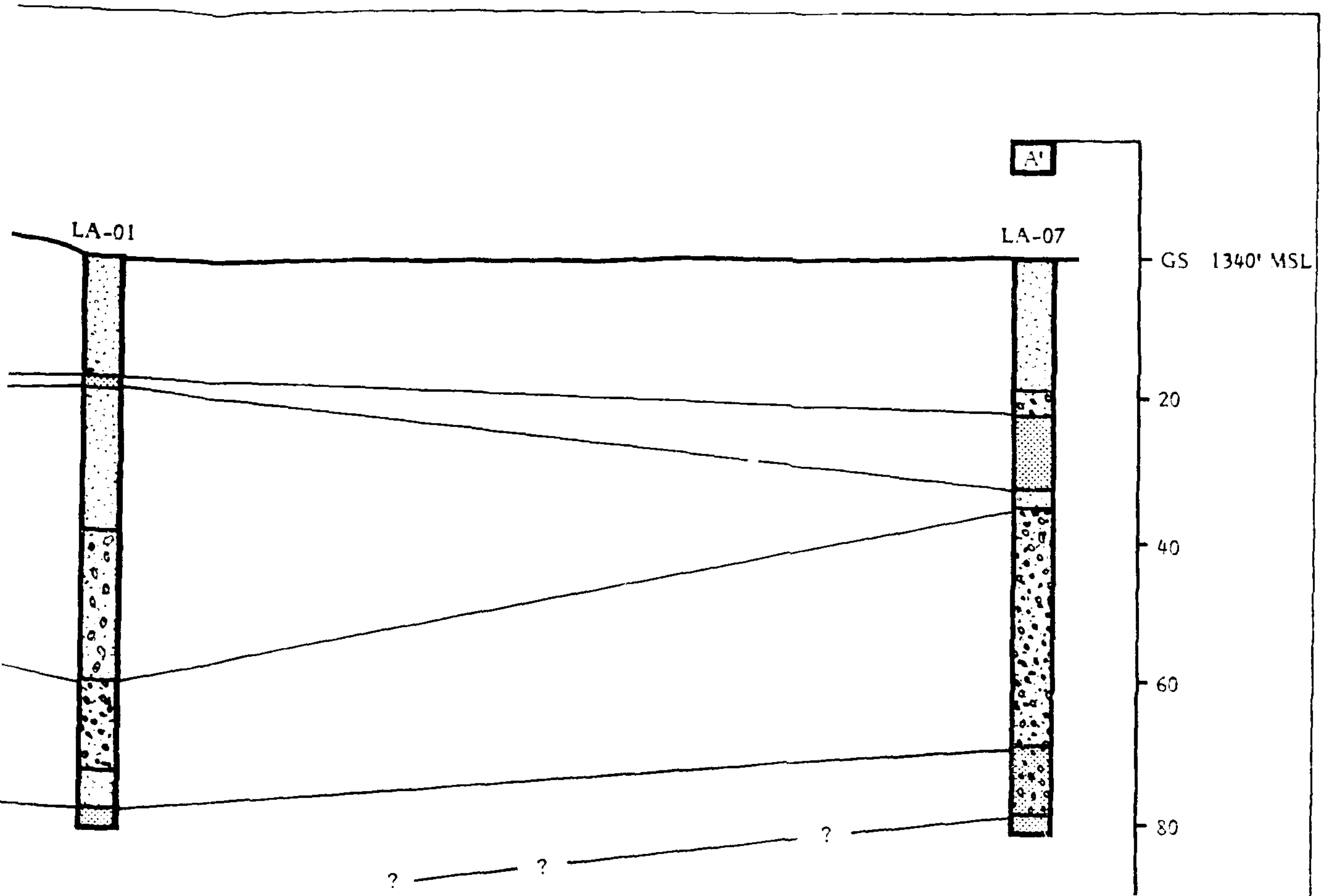

A
LA-04
LA-01
GS
20
40
60
80
?
LEGEND
Clay and/or Clayey Sand
Silt to Medium Sand
Medium to Very Coarse Sand
Gravel
0
250
500
750
Horizontal Scale: 1 inch = 250 feet
Drawn from Boring Logs
Obtained during Drilling Program
October 1984



:0 500 750

Scale: 1 inch = 250 feet

1 from Boring Logs
during Drilling Program
October 1984

2

Figure IV-2
Cross Section A-A'

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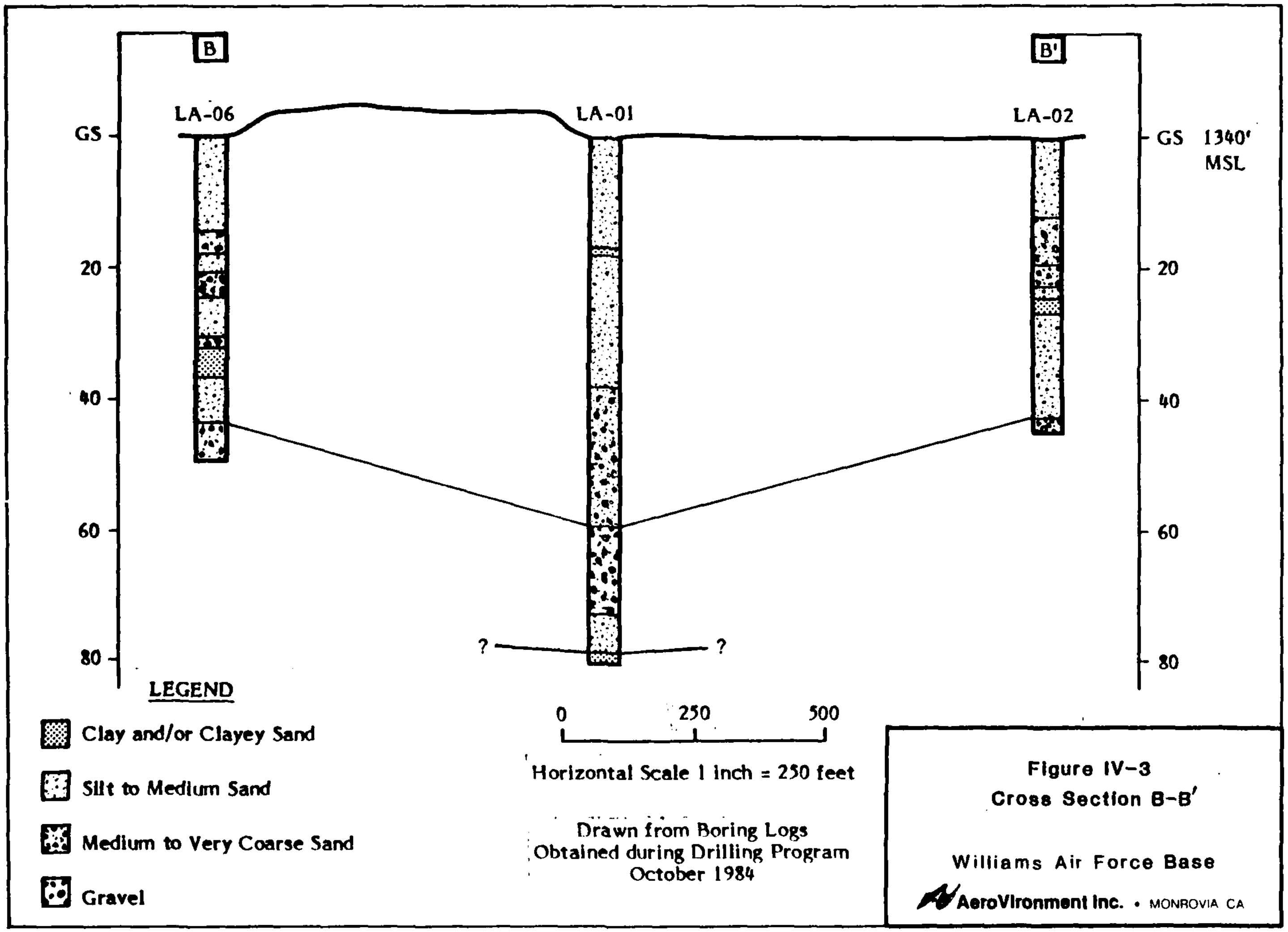

Figure IV-3
Cross Section B-B'

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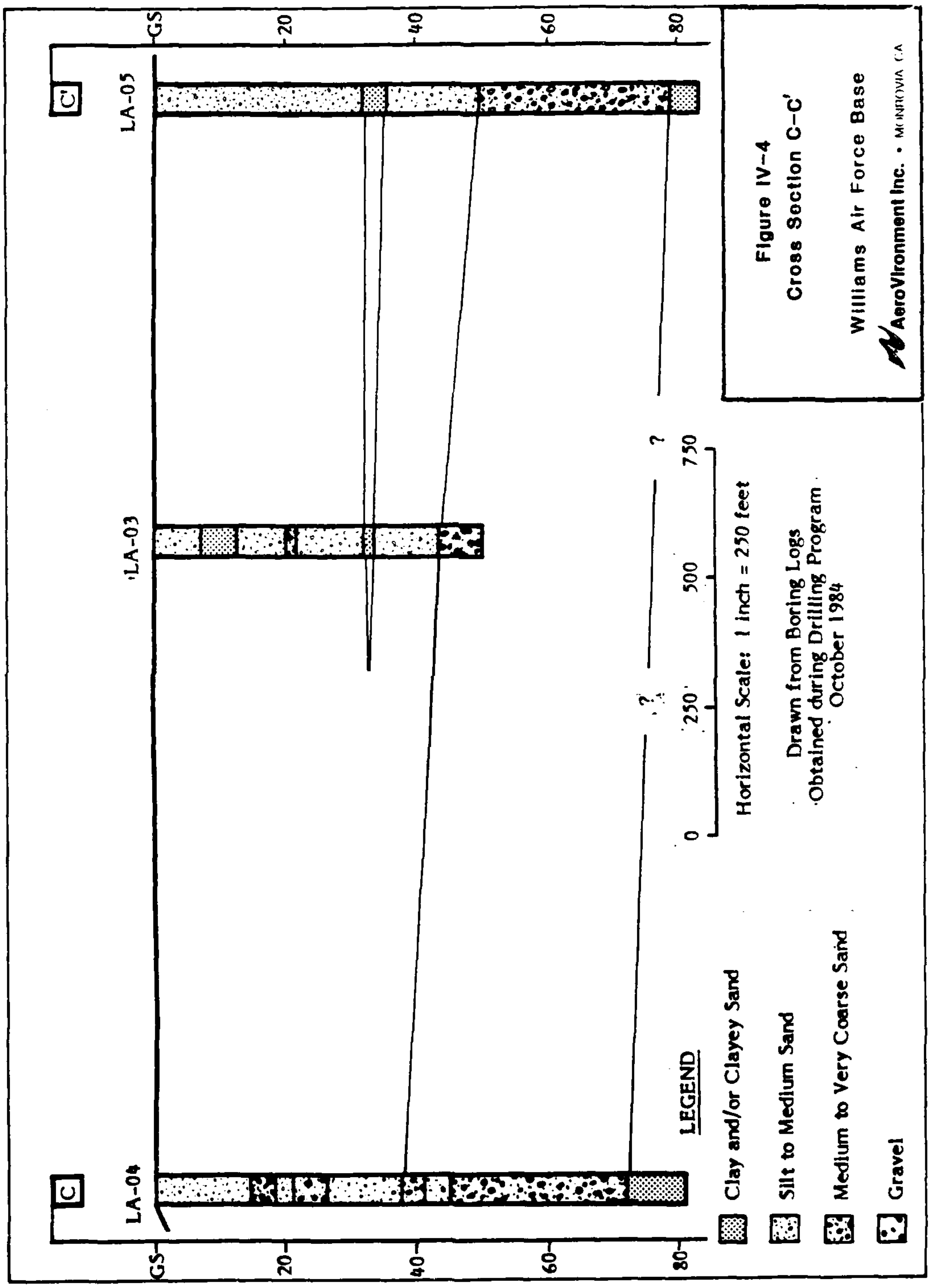

Figure IV-4
Cross Section C–C'

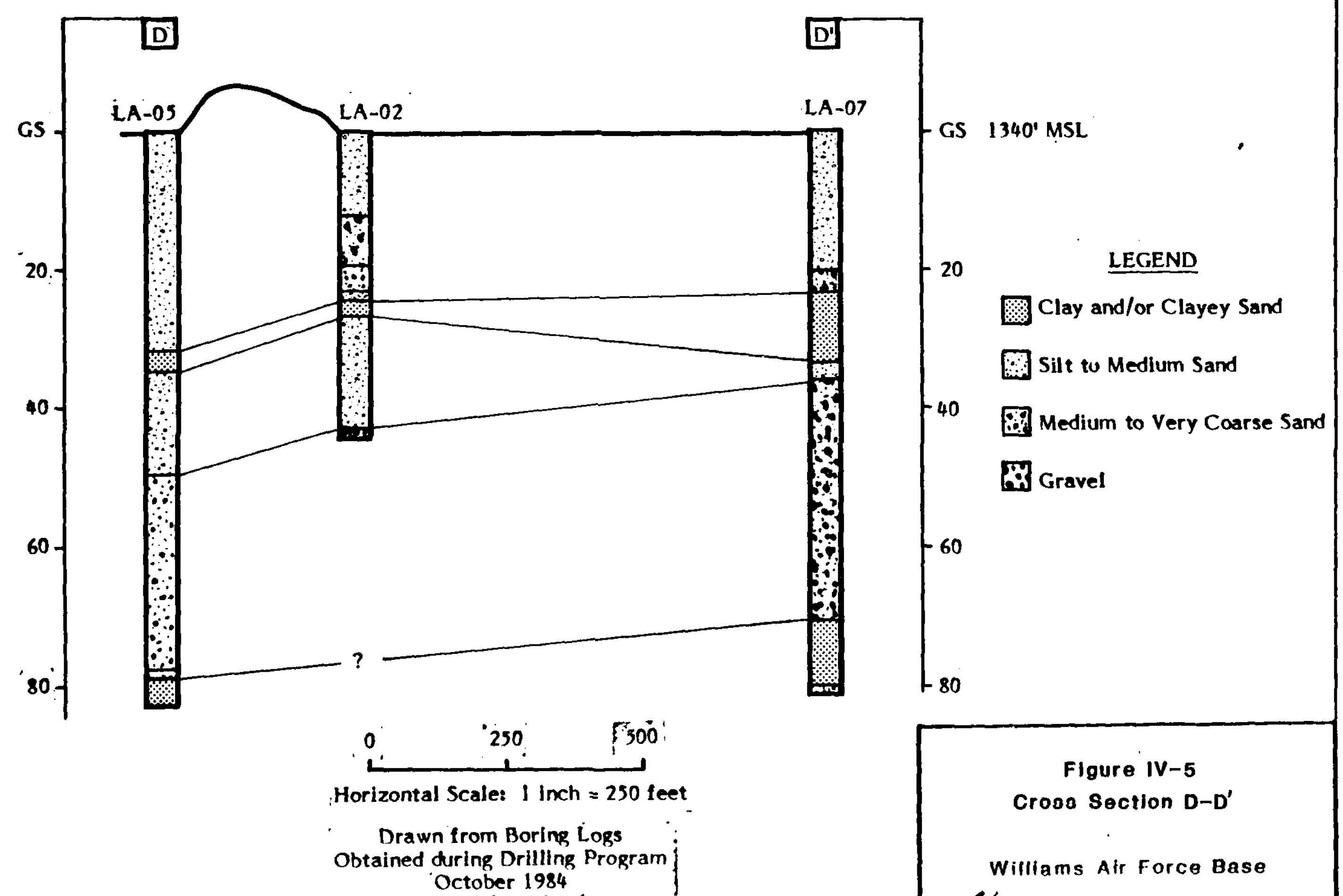

Figure IV-5
Cross Section D–D'

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the soils. The upper unit showed good permeability and was found starting at 4-7 feet below ground surface in all our borings on base.

Starting at 35-40 feet and continuing to 70-80 feet was a clean, very coarse sand and gravel. During our drilling at the landfill, we used this middle unit as a "marker" and all our borings at this site were extended until the middle unit was found. The permeability of this unit was very good, estimated from core samples in the field to be about 10^{-1} or 10^{-2} cm/sec. This "marker" was also encountered in the one deep (45 foot) hole drilled at the liquid fuels storage area, an area nearly one mile from the landfill, so there is a distinct possibility that the middle unit is found under the entire base.

In our four deep borings (to 80 feet), we encountered a clay that forms the lowest layer starting at 70-80 feet. This clay was encountered consistently throughout the landfill area and was dependably found at the expected depth. (By plotting the elevation above MSL that the clay was encountered we have shown that the upper surface of the clay forms a gently dipping erosional surface, which apparently runs between LA-01 and LA-03, dips gently (0.4%) towards the northwest.) We were unable to determine the lower extent of this clay layer.

Given the consistency of the upper two units and the fact that this is an alluvial filled valley, the probability that the clay underlies the entire base is quite good. There is also a good possibility, however, that the clay may be discontinuous and thus form a zone of low intrinsic hydraulic conductivity that would inhibit any percolation of liquid from the surface, but not stop it all together.

Lithologic logs of all hollow stem auger borings may be found in Appendix D.

2. Groundwater

We encountered no groundwater during any of our borings at Williams AFB. Discussions with hydrologists and geologists at the United States

Geological Survey - Water Resources Division and Arizona Department of Water Resources, along with information generated by the Phase I report, have shown two distinct aquifers that underlie the base. This was also verified by USGS Water Resource Investigation 78-61.

The upper aquifer is perched and is found at about 200 feet below ground level. This aquifer is unconfined and is found under the western three-quarters of the base. There are still "quite a number" (Arizona Department of Water Resources terminology) of wells that tap this aquifer in the area around the base. These wells are generally small agricultural wells. We have found no chemical analyses from any of these shallow wells.

The lower aquifer is confined in the entire area around Williams AFB. This artesian aquifer has a piezometric surface of about 400 feet below ground surface in the area near the base. The wells on base that tap this aquifer are 850 to 1,000 feet deep, and there have been no water quality problems with these wells. The fact that the lower aquifer is confined under Williams Air Force Base was verified by checking the lithologic logs of basewater supply wells.

3. Magnetometer Results

Two magnetometer surveys were conducted at the pesticide burial area at Williams AFB, the first on September 24, 1984, and the second on October 11, 1984. The data collected in the two surveys have been mapped on a grid system and are presented as Figures J-1 and J-2 of Appendix J. The data sets for the two surveys are similar, but with some striking differences. These differences arise because large metal signs were present at stations (D+5,35), (D+5,115), and (G,110) for the September 22, 1984, survey, but were removed for the October 11, 1984, survey. The October 11, 1984, contour data are thus much more meaningful for the regions surrounding these stations. Elsewhere, both maps have virtually identical anomaly patterns, demonstrating the reliability of the survey method used in this project.

The pattern of anomalously high magnetic values to the south and low values to the north on the October 11, 1984, contour map strongly indicates that induced magnetism dominated remanent magnetism (that of a magnet) in the source body. This is an essential assumption for the interpretation method used during this survey.

The depth of the canister(s) from the observed magnetic anomaly is interpreted by assuming the canister(s) forms a spherical body. Using two-dimensional north-south profiles over the body, the half-width (width at half the peak value) of the anomaly is roughly equal to the distance between the sensor and the center of the spherical body (Telford, 1982). An experimental test was performed on October 24, 1984, at the University of Arizona to confirm the accuracy of this method. A north-south profile was made over two 55-gallon metal drums placed 12 feet beneath the sensor. The calculated half-width for this anomaly agrees with the 12-foot depth value to within one foot.

The peak magnetic amplitude will generally not occur directly over the top of the causal body. However, knowing the location of the peak amplitude, the inclination of the earth's magnetic field, and the depth to the anomalous body, a simple trigonometric equation provides the true surface location of the anomalous body. At Williams AFB, the true surface location will be north of the magnetic high at a point equal to the depth divided by $\tan 60^{\circ}$.

A qualitative interpretation of the size of the anomalous bodies is possible by comparing the magnitude of the Williams AFB anomalies to the University of Arizona test data. Because both depth estimates are very similar, the magnitude of the anomalies should be similar if the containers are composed of the same volume of the same type of metal. Instead, the magnitude of the Williams AFB anomaly is significantly greater and its source may contain more metal than the two 55-gallon drums used in the University of Arizona experiment.

4. Analytical Results

The analytical results from soil sample analysis show that several locations on the base have been contaminated. The laboratory results show that oil

and grease is the most common contaminant found at Williams AFB. Lead was also frequently found. Total organic halogens and phenol were not found in the majority of samples. Other analytes were not of concern at all sites and so were not prominent. In most cases, laboratory results confirmed field observations related to soil staining, odors, and organic vapor readings.

The results of all completed analyses are shown in Tables IV-1 through IV-40. Each sampling location has been given a separate table as follows:

FPTA Holes 1-15	Tables IV-1 to IV-15
LFSA Holes 1-7, 9	Tables IV-16 to IV-23
Landfill Holes 1-7	Tables IV-24 to IV-30
SW Drainage Holes 1-6	Tables IV-31 to IV-36
NW Drainage Holes 1-4	Tables IV-37 to IV-40

As mentioned previously, not all the samples collected were analyzed in the laboratory. However, all collected samples are shown on Tables IV-1 through IV-40 to show where geologic information was gathered. The laboratory reports submitted by Acurex on all results, including laboratory quality assurance results, are included in Appendix G.

As indicated in the data tables, there were several areas of contaminated soil at the FPTA. The samples taken at the separator drain pipe (discharging into the drainage channel) were found to have high concentrations of oil and grease. These samples were observed to be very oily when they were collected. In addition, surface contamination (oil and grease) was found in several holes around the burn pits. This is probably related to spills and "slop" from present day activities at the site. Two holes near the small burn pit are contaminated with oil and grease throughout the depths investigated in this sampling program. (Phenol concentrations were found above background levels.) No lead problems were found in any of the FPTA samples.

The liquid fuels storage area was found to have several areas of surface contamination (in the range of zero to four feet in depth). This

TABLE IV-1. Fire Protection Training Area, Hole 1.

Code	Lab No.	Depth	Analysis Results (µg/g)			
			Phenol	O&G	Lead	TOX
FP-01-01	8410-012-03	Surface	3.4	41,000	38	1
FP-01-02	8410-012-04	2.0 - 2.5	ND	1,100	23	ND

TABLE IV-2. Fire Protection Training Area, Hole 2.

Code	Lab No.	Depth	Analysis Results (µg/g)			
			Phenol	O&G	Lead	TOX
FP-02-01	8410-012-01	Surface	2.2	90	34	ND
FP-02-02	8410-012-02	3.0 - 3.5	ND	ND	25	ND

NA = no lab number assigned; ND = not detected; — = not analyzed.

TABLE IV-3. Fire Protection Training Area, Hole 3.

Code	Lab No.	Depth	Analysis Results (µg/g)			
			Phenol	O&G	Lead	TOX
FP-03-01	8409-033-5	0.5 - 1.0	1.1	70	21	ND
FP-03-02	8409-033-6	1.5 - 2.0	ND	4,000	19	ND
FP-03-03	8409-033-7	3.0 - 3.5	ND	ND	19	ND
FP-03-04	NA	5.0 - 5.5	--	--	--	--
FP-03-05	NA	7.0 - 7.5	--	--	--	--
FP-03-06	8409-033-9	9.0 - 9.5	ND	ND	11	ND

NA = no lab number assigned; ND = not detected; — = not analyzed.

TABLE IV-4. Fire Protection Training Area, Hole 4.

Code	Lab No.	Depth	Analysis Results (µg/g)			
			Phenol	O&G	Lead	TOX
FP-04-01	8409-033-10	1.0 - 1.5	ND	860	13	ND
FP-QA-01	8409-033-12	2.0 - 2.5	ND	ND	16	ND
FP-04-02	8409-033-13	2.5 - 3.0	ND	ND	21	1
FP-04-03	8409-033-11	3.5 - 4.0	ND	ND	19	ND
FP-04-04	NA	5.5 - 6.0	--	--	--	--
FP-04-05	NA	7.0 - 7.5	--	--	--	--
FP-04-06	NA	9.0 - 9.5	--	--	--	--
FP-QA-02	8409-033-14	11.5 - 12.0	ND	90	6	ND
FP-04-07	8409-033-21	12.0 - 12.5	ND	ND	8	ND
FP-04-08	8409-033-15	13.5 - 14.0	ND	ND	5	ND

NA = no lab number assigned; ND = not detected; — = not analyzed.

TABLE IV-5. Fire Protection Training Area, Hole 5.

Code	Lab No.	Depth	Analysis Results (µg/g)			
			Phenol	O&G	Lead	TOX
FP-05-01	8409-033-16	1.0 - 1.5	1.0	ND	8	ND
FP-05-02	8409-033-17	3.0 - 3.5	ND	ND	21	1
FP-05-03	8409-033-22	6.0 - 6.5	ND	ND	13	ND
FP-05-04	8409-033-23	9.0 - 9.5	ND	ND	9	ND

TABLE IV-6. Fire Protection Training Area, Hole 6.

Code	Lab No.	Depth	Analysis Results (µg/g)			
			Phenol	O&G	Lead	TOX
FP-06-01	8409-033-18	1.0 - 1.5	0.5	860	53	1
FP-QA-03	8409-033-20	3.0 - 3.5	ND	ND	20	ND
FP-06-02	8409-033-19	3.5 - 4.0	ND	ND	17	ND
FP-06-03	8409-033-24	5.0 - 5.5	ND	ND	14	ND
FP-06-04	NA	7.0 - 7.5	--	--	--	--
FP-06-05	NA	9.0 - 9.5	--	--	--	--
FP-06-06	NA	11.0 - 11.5	--	--	--	--
FP-QA-04	8409-033-25	13.0 - 13.5	ND	ND	9	ND
FP-06-07	8409-033-27	13.5 - 14.0	ND	ND	6	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-7. Fire Protection Training Area, Hole 7.

Code	Lab No.	Depth	Analysis Results (µg/g)			
			Phenol	O&G	Lead	TOX
FP-07-01	8409-033-28	1.0 - 1.5	ND	ND	17	2
FP-07-02	8409-033-29	3.0 - 3.5	ND	ND	20	ND
FP-07-03	8409-033-30	5.0 - 5.5	ND	ND	9	1
FP-07-04	8411-001-11	7.0 - 7.5	--	--	--	ND
FP-07-05	8409-033-31	9.0 - 9.5	ND	ND	8	6

TABLE IV-8. Fire Protection Training Area, Hole 8.

Code	Lab No.	Depth	Analysis Results (µg/g)			
			Phenol	O&G	Lead	TOX
FP-08-01	8409-033-34	2.0 - 2.5	ND	2,200	24	1
FP-08-02	8409-033-32	3.0 - 3.5	ND	14,000	17	1
FP-08-03	8409-033-33	4.0 - 4.5	1.0	29,000	21	1
FP-08-04	8411-001-1	6.0 - 6.5	ND	ND	11	ND
FP-08-05	NA	8.0 - 8.5	--	--	--	--
FP-QA-05	8409-033-26	10.0 - 10.5	ND	ND	10	ND
FP-08-06	8409-033-35	10.5 - 11.0	ND	ND	7	ND
FP-08-07	NA	12.0 - 12.5	--	--	--	--
FP-08-08	8409-033-36	14.0 - 14.5	ND	ND	5	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-9. Fire Protection Training Area, Hole 9.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
FP-09-01	8409-033-37	3.0 - 3.5	0.9	1,300	58	2
FP-09-02	8409-033-38	4.0 - 4.5	1.1	1.500	16	1
FP-09-03	8409-033-39	5.0 - 5.5	2.0	9,500	13	1
FP-09-04	8411-001-2	6.0 - 6.5	2.3	6,600	--	1
FP-09-05	8411-038-1	7.0 - 7.5	--	8,500	13	--
FP-09-06	8411-001-3	8.0 - 8.5	3.4	4,900	--	--
FP-09-07	8409-033-40	9.0 - 9.5	3.1	6,400	6	1
FP-09-08	8411-001-4	11.0 - 11.5	2.2	6,700	--	--
FP-09-09	8411-038-2	13.5 - 14.0	--	10,000	8	--
FP-09-10	8411-001-5	18.5 - 19.0	--	9,500	--	--
FP-09-11	8409-033-64	23.5 - 24.0	ND	7,600	5	1

NA = no lab number assigned; ND = not detected; — = not analyzed.

TABLE IV-10. Fire Protection Training Area, Hole 10.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
FP-10-01	8409-033-41	3.5 - 4.0*	1.4	290	22	2
FP-10-02	8409-033-43	8.5 - 9.0	ND	150	17	1
FP-10-03	8409-033-42	2.0 - 2.5	ND	300	21	1
FP-10-04	8409-033-44	3.5 - 4.0	ND	920	16	ND
FP-10-05	8411-001-6	5.5 - 6.0	--	ND	--	--
FP-10-06	NA	7.0 - 7.5	--	--	--	--
FP-10-07	8409-033-45	8.5 - 9.0	ND	ND	19	ND

*First hole attempted did not provide sufficient number of samples, second hole drilled 2 feet from first attempt.

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-11. Fire Protection Training Area, Hole 11.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
FP-QA-06	8409-033-48	1.5 - 2.0	ND	50	10	ND
FP-11-01	8409-033-47	2.0 - 2.5	ND	ND	12	ND
FP-11-02	8409-033-46	3.5 - 4.0	ND	ND	18	ND
FP-11-03	8409-033-49	5.0 - 5.5	ND	ND	14	ND
FP-11-04	NA	7.0 - 7.5	--	--	--	--
FP-11-05	8409-033-52	9.0 - 9.5	ND	ND	6	ND

TABLE IV-12. Fire Protection Training Area, Hole 12.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
FP-12-01	8409-033-50	1.0 - 1.5	ND	ND	17	ND
FP-12-02	NA	3.0 - 3.5	--	--	--	--
FP-12-03	8409-033-51	5.0 - 5.5	ND	ND	12	ND
FP-12-04	NA	7.0 - 7.5	--	--	--	--
FP-12-05	8409-033-53	9.0 - 9.5	ND	ND	8	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-13. Fire Protection Training Area, Hole 13.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
FP-13-01	8409-033-55	1.5 - 2.0	1.4	12,000	22	2
FP-13-02	8409-033-54	2.5 - 3.0	ND	ND	21	ND
FP-13-03	8409-033-56	3.5 - 4.0	ND	ND	20	ND
FP-13-04	8411-001-7	5.0 - 5.5	--	--	10	--
FP-13-05	NA	7.0 - 7.5	--	--	--	--
FP-13-06	8409-033-57	9.0 - 9.5	ND	ND	7	ND

TABLE IV-14. Fire Protection Training Area, Hole 14.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
FP-14-01	8409-033-1	1.0 - 1.5	ND	60	7	ND
FP-14-02	8409-033-8	3.0 - 3.5	ND	ND	19	ND
FP-14-03	8409-033-2	5.0 - 5.5	ND	ND	12	ND
FP-14-04	8409-033-4	7.0 - 7.5	ND	ND	5	ND
FP-14-05	8409-033-3	9.0 - 9.5	ND	ND	ND	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-15. Fire Protection Training Area, Hole 15.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
FP-15-01	8409-033-58	0.5 - 1.0	0.5	140	18	ND
FP-15-02	8409-033-59	1.5 - 2.0	3.0	16,000	17	1
FP-15-03	8409-033-60	2.5 - 3.0	1.2	16,000	4	1
FP-15-04	8411-001-8	3.5 - 4.0	0.8	13,000	--	ND
FP-QA-07	8409-033-61	5.0 - 5.5	ND	14,000	12	ND
FP-15-05	8409-033-62	5.5 - 6.0	0.5	18,000	12	1
FP-15-06	8411-001-9	8.5 - 9.0	--	14,000	--	1
FP-15-07	8411-001-10	11.0 - 11.5	--	7,000	--	--
FP-15-08	8409-033-63	13.5 - 14.0	ND	5,500	8	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

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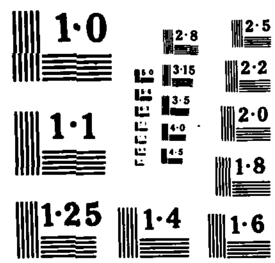
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TABLE IV-16. Liquid Fuels Storage Area, Hole 1.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
LI-01-01	NA	0.5 - 1.0	--	--	--	--
LI-01-02	NA	2.0 - 2.5	--	--	--	--
LI-01-03	8409-033-71	3.5 - 4.0	ND	ND	13	ND
LI-01-04	NA	6.0 - 6.5	--	--	--	--
LI-01-05	8409-033-72	7.5 - 8.0	ND	ND	8	1
LI-01-06	8409-033-73	9.0 - 9.5	ND	ND	9	ND

TABLE IV-17. Liquid Fuels Storage Area, Hole 2.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
LI-02-01	NA	1.0 - 1.5	--	--	--	--
LI-02-02	8409-033-74	3.0 - 3.5	ND	ND	11	ND
LI-QA-02	8409-033-75	5.0 - 5.5	ND	ND	11	ND
LI-02-03	NA	5.5 - 6.0	--	--	--	--
LI-02-04	8409-033-76	7.0 - 7.5	ND	ND	7	ND
LI-02-05	8409-033-77	9.0 - 9.5	ND	ND	7	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-18. *Liquid Fuels Storage Area, Hole 3.*

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
LI-QA-03	8411-026-03	2.5 - 3.0	ND	ND	24	ND
LI-03-01	NA	3.0 - 3.5	--	--	--	--
LI-03-02	8411-026-02	5.5 - 6.0	--	--	160	--
LI-03-03	8410-007-20	8.5 - 9.0	ND	ND	520	ND
LI-03-04	8411-026-04	13.5 - 14.0	--	--	840	--
LI-03-05	8411-026-05	16.0 - 16.5	--	130	830	--
LI-03-06	8410-007-23	18.5 - 19.0	ND	430	680	ND
LI-03-07	8410-007-21	21.0 - 21.5	0.5	340	700	ND
LI-03-08	8410-007-24	23.5 - 24.0	4.7	720	1,100	ND
LI-03-09	8410-007-22	28.5 - 29.0	2.3	1,400	890	8
LI-03-10	8410-007-25	33.5 - 34.0	7.5	2,500	660	4
LI-03-11	8410-007-26	38.5 - 39.0	ND	70	260	ND
LI-03-12	8410-007-29	44.0 - 44.5	ND	320	220	3

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-19. Liquid Fuels Storage Area, Hole 4.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
LI-04-01	8410-007-27	1.0 - 1.5	ND	ND	16	ND
LI-04-02	8410-007-30	3.0 - 3.5	ND	ND	12	ND
LI-04-03	8410-007-28	5.0 - 5.5	ND	ND	7	ND
LI-QA-04	8411-026-06	7.0 - 7.5	ND	ND	7	ND
LI-04-04	8410-007-31	7.5 - 8.0	ND	ND	6	ND
LI-04-05	8410-007-33	9.0 - 9.5	ND	ND	5	ND

TABLE IV-20. Liquid Fuels Storage Area, Hole 5.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
LI-05-01	8410-007-35	2.0 - 2.5	ND	340	56	ND
LI-05-02	8410-007-38	3.5 - 4.0	ND	70	23	ND
LI-05-03	NA	6.0 - 6.5	--	--	--	--
LI-05-04	8410-007-32	8.0 - 8.5	ND	ND	11	ND
LI-05-05	NA	9.0 - 9.5	--	--	--	--

NA = no lab number assigned; ND = not detected; — = not analyzed.

TABLE IV-21. Liquid Fuels Storage Area, Hole 6.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
LI-QA-05	8411-026-07	3.0 - 3.5	0.6	80	64	2
LI-06-01	8410-007-36	3.5 - 4.0	1.0	110	51	ND
LI-06-02	8410-007-39	7.0 - 7.5	ND	ND	11	ND
LI-06-03	8410-007-34	8.5 - 9.0	ND	ND	7	ND

TABLE IV-22. Liquid Fuels Storage Area, Hole 7.

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
LI-07-01	8410-007-37	1.0 - 1.5	ND	ND	60	ND
LI-07-02	8410-007-40	3.0 - 3.5	ND	ND	15	ND
LI-07-03	8410-007-41	5.0 - 5.5	ND	ND	7	ND
LI-07-04	NA	7.0 - 7.5	--	--	--	--
LI-07-05	8410-007-42	9.0 - 9.5	ND	ND	8	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-23. Liquid Fuels Storage Area, Hole 9.*

Code	Lab No.	Depth	Analysis Results (μg/g)			
			Phenol	O&G	Lead	TOX
LI-QA-01	8409-033-67	0.5 - 1.0	ND	ND	20	1
LI-09-01	8409-033-65	1.0 - 1.5	ND	ND	18	ND
LI-09-02	8409-033-68	3.0 - 3.5	ND	ND	11	ND
LI-09-03	8409-033-66	5.0 - 5.5	ND	ND	9	ND
LI-09-04	8409-033-69	7.0 - 7.5	ND	ND	8	ND
LI-09-05	8409-033-70	9.0 - 9.5	ND	80	5	1

*There was no hole No. 8.

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-24. Landfill, Hole 1.

Code	Lab No.	Depth	Analysis Results (μg/g)					
			Phenol	O&G	Lead	Chrome	Cad.	TOX
LA-01-01	NA	3.5 - 4.0	--	--	--	--	--	--
LA-01-02	NA	8.5 - 9.0	--	--	--	--	--	--
LA-01-03	8411-026-13	13.5 - 14.0	ND	ND	16	19	ND	--
LA-01-04	NA	18.5 - 19.0	--	--	--	--	--	--
LA-01-05	NA	21.0 - 21.5	--	--	--	--	--	--
LA-01-06	8411-026-14	23.5 - 24.0	ND	ND	10	13	ND	--
LA-01-07	NA	26.0 - 26.5	--	--	--	--	--	--
LA-01-08	NA	28.5 - 29.0	--	--	--	--	--	--
LA-01-09	8410-007-8	31.5 - 32.0	ND	ND	9	17	ND	ND
LA-01-10	NA	33.5 - 34.0	--	--	--	--	--	--
LA-01-11	NA	38.5 - 39.0	--	--	--	--	--	--
LA-01-12	8410-007-9	49.5 - 50.0	ND	ND	7	10	ND	ND
LA-01-13	NA	58.5 - 59.0	--	--	--	--	--	--
LA-01-14	NA	73.0 - 73.5	--	--	--	--	--	--
LA-01-15	8410-007-10	79.5 - 80.0	ND	ND	7	14	ND	ND

NA = no lab number assigned; ND = not detected; — = not analyzed.

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TABLE IV-25. Landfill, Hole 2.

Code	Lab No.	Depth	Analysis Results (μg/g)					
			Phenol	O&G	Lead	Chrome	Cad.	TOX
LA-02-01	NA	8.5 - 9.0	--	--	--	--	--	--
LA-02-02	NA	13.5 - 14.0	--	--	--	--	--	--
LA-QA-02	8411-026-08	18.0 - 18.5	ND	ND	9	11	ND	ND
LA-02-03	8410-007-11	18.5 - 19.0	ND	ND	8	10	ND	ND
LA-02-04	NA	23.5 - 24.0	--	--	--	--	--	--
LA-02-05	NA	26.0 - 26.5	--	--	--	--	--	--
LA-02-06	8410-007-12	28.5 - 29.0	ND	ND	12	17	ND	ND
LA-02-07	NA	31.5 - 32.0	--	--	--	--	--	--
LA-02-08	NA	33.5 - 34.0	--	--	--	--	--	--
LA-02-09	8410-007-13	36.0 - 36.5	ND	ND	9	11	ND	ND
LA-02-10	NA	38.5 - 39.0	--	--	--	--	--	--
LA-02-11	8410-007-15	43.5 - 44.0	ND	ND	6	8	ND	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-26. Landfill, Hole 3.

Code	Lab No.	Depth	Analysis Results (μg/g)					
			Phenol	O&G	Lead	Chrome	Cad.	TOX
LA-03-01	NA	3.5 - 4.0	--	--	--	--	--	--
LA-03-02	8411-026-09	8.5 - 9.0	--	--	--	14	--	--
LA-03-03	8410-007-14	13.5 - 14.0	ND	ND	11	26	ND	ND
LA-QA-03	8411-026-10	18.0 - 18.5	ND	ND	9	14	ND	ND
LA-03-04	8411-026-11	18.5 - 19.0	--	--	--	9	--	--
LA-03-05	NA	21.0 - 21.5	--	--	--	--	--	--
LA-03-06	8410-007-17	23.5 - 24.0	ND	ND	9	15	ND	ND
LA-03-07	NA	26.0 - 26.5	--	--	--	--	--	--
LA-03-08	NA	28.5 - 29.0	--	--	--	--	--	--
LA-03-09	8410-007-16	31.0 - 31.5	ND	ND	8	15	ND	ND
LA-03-10	NA	33.5 - 34.0	--	--	--	--	--	--
LA-03-11	NA	36.5 - 37.0	--	--	--	--	--	--
LA-03-12	8410-007-18	38.5 - 39.0	ND	ND	8	7	ND	ND
LA-03-13	NA	43.5 - 44.0	--	--	--	--	--	--
LA-QA-04	8411-026-12	48.0 - 48.5	ND	ND	8	8	ND	ND
LA-03-14	8410-007-19	48.5 - 49.0	ND	ND	5	6	ND	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-27. Landfill, Hole 4.

Code	Lab No.	Depth	Analysis Results (μg/g)					
			Phenol	O&G	Lead	Chrome	Cad.	TOX
LA-04-01	NA	3.5 - 4.0	--	--	--	--	--	--
LA-04-02	8411-039-08	8.5 - 9.0	--	--	10	8	--	--
LA-QA-05	8410-009-10	13.0 - 13.5	ND	ND	13	18	ND	ND
LA-04-03	8410-009-11	13.5 - 14.0	ND	ND	12	20	ND	ND
LA-04-04	8411-039-01	18.5 - 19.0	--	--	16	6	--	--
LA-04-05	8411-039-02	23.5 - 24.0	--	--	7	--	--	--
LA-04-06	8410-009-01	26.5 - 27.0	ND	ND	13	17	ND	ND
LA-04-07	8411-039-03	28.5 - 29.0	--	--	8	--	--	--
LA-04-08	NA	36.0 - 36.5	--	--	--	--	--	--
LA-04-09	8410-009-02	38.5 - 39.0	ND	ND	12	16	ND	ND
LA-04-10	NA	43.5 - 44.0	--	--	--	--	--	--
LA-04-11	NA	48.5 - 49.0	--	--	--	--	--	--
LA-04-12	8410-009-12	53.5 - 54.0	ND	ND	7	7	ND	ND
LA-04-13	NA	58.5 - 59.0	--	--	--	--	--	--
LA-04-14	8410-009-13	63.5 - 64.0	ND	ND	5	11	ND	ND
LA-04-15	NA	68.5 - 69.0	--	--	--	--	--	--
LA-04-16	8410-009-14	73.5 - 74.0	ND	ND	9	14	ND	ND

NA = no lab number assigned; ND = not detected; — = not analyzed.

TABLE IV-28. Landfill, Hole 5.

Code	Lab No.	Depth	Analysis Results (μg/g)					
			Phenol	O&G	Lead	Chrome	Cad.	TOX
LA-05-01	NA	8.5 - 9.0	--	--	--	--	--	--
LA-05-02	8411-039-09	18.5 - 19.0	--	--	8	7	--	--
LA-05-03	8410-099-15	28.5 - 29.0	ND	ND	14	21	ND	ND
LA-05-04	8411-039-10	33.5 - 34.0	--	--	9	13	--	--
LA-QA-06	8410-099-16	38.0 - 38.5	ND	ND	16	16	ND	ND
LA-05-05	8410-099-17	38.5 - 39.0	ND	ND	13	16	ND	ND
LA-05-06	8410-099-18	43.5 - 44.0	ND	ND	19	9	ND	ND
LA-05-07	8411-039-11	47.0 - 47.5	--	--	7	--	--	--
LA-05-08	8411-039-13	59.5 - 60.0	--	--	--	11	--	--
LA-05-09	8410-099-19	69.5 - 70.0	ND	ND	7	20	ND	ND
LA-05-10	8411-039-12	80.0 - 80.5	--	--	--	10	--	--
LA-05-11	8410-099-03	82.5 - 83.0	ND	ND	11	12	ND	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

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TABLE IV-29. Landfill, Hole 6.

Code	Lab No.	Depth	Analysis Results (µg/g)					
			Phenol	O&G	Lead	Chrome	Cad.	TOX
LA-06-01	NA	3.5 - 4.0	--	--	--	--	--	--
LA-06-02	8411-039-04	8.5 - 9.0	--	--	11	16	--	--
LA-06-03	8410-099-04	13.5 - 14.0	ND	ND	12	22	ND	ND
LA-06-04	8411-039-05	18.5 - 19.0	--	--	10	9	--	--
LA-06-05	NA	23.5 - 24.0	--	--	--	--	--	--
LA-06-06	8410-099-05	26.0 - 26.5	ND	ND	10	14	ND	ND
LA-QA-07	8410-099-08	28.0 - 28.5	ND	ND	10	15	ND	ND
LA-06-07	8410-099-06	28.5 - 29.0	ND	ND	10	16	ND	ND
LA-06-08	8411-039-06	31.0 - 31.5	--	--	--	12	--	--
LA-06-09	8410-099-07	33.5 - 34.0	ND	ND	8	25	ND	ND
LA-06-10	8411-039-07	38.5 - 39.0	--	--	--	7	--	--
LA-06-11	NA	43.5 - 44.0	--	--	--	--	--	--
LA-06-12	8410-099-09	48.5 - 49.0	ND	ND	8	5	ND	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-30. Landfill, Hole 7.

Code	Lab No.	Depth	Analysis Results (μg/g)					
			Phenol	O&G	Lead	Chrome	Cad.	TOX
LA-07-01	NA	3.5 - 4.0	--	--	--	--	--	--
LA-07-02	NA	8.5 - 9.0	--	--	--	--	--	--
LA-07-03	8410-007-01	13.5 - 14.0	ND	ND	9	11	ND	ND
LA-QA-01	8411-027-01	18.0 - 18.5	ND	ND	12	17	ND	ND
LA-07-04	8410-007-02	18.5 - 19.0	ND	ND	8	13	ND	ND
LA-07-05	NA	23.5 - 24.0	--	--	--	--	--	--
LA-07-06	8410-007-03	26.0 - 26.5	ND	ND	7	9	ND	ND
LA-07-07	NA	28.5 - 29.0	--	--	--	--	--	--
LA-07-08	NA	31.0 - 31.5	--	--	--	--	--	--
LA-07-09	8410-007-04	33.5 - 34.0	ND	ND	7	9	ND	ND
LA-07-10	NA	38.5 - 39.0	--	--	--	--	--	--
LA-07-11	NA	43.5 - 44.0	--	--	--	--	--	--
LA-07-12	8410-007-05	48.5 - 49.0	ND	ND	4	6	ND	ND
LA-07-13	NA	54.0 - 54.5	--	--	--	--	--	--
LA-07-14	NA	59.0 - 59.5	--	--	--	--	--	--
LA-07-15	8410-007-06	68.5 - 69.0	ND	ND	8	13	ND	ND
LA-07-16	NA	74.0 - 74.5	--	--	--	--	--	--
LA-07-17	8410-007-07	79.0 - 79.5	ND	ND	7	17	ND	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

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TABLE IV-31. Southwest Drainage System, Hole 1.

Code	Lab No.	Depth	Analysis Results (μg/g)								
			Phenol	O&G	Lead	Chrome	Cad.	TOX	Copper	Cyanide	MEK
SW-01-01	8410-012-17	Surface	1.9	100,000	1,500	470	90.0	14	180	ND	ND
SW-01-02	8410-012-20	1.5 - 2.0	3.6	13,000	100	53	8.2	4	33	ND	ND

TABLE IV-32. Southwest Drainage System, Hole 2.

Code	Lab No.	Depth	Analysis Results (μg/g)								
			Phenol	O&G	Lead	Chrome	Cad.	TOX	Copper	Cyanide	MEK
SW-02-01	8410-012-13	Surface	ND	11,000	680	190	44.0	10	130	ND	.028
SW-02-02	8410-012-15	1.25 - 1.75	ND	130	24	27	3.0	1	17	ND	ND

NA = no lab number assigned; ND = not detected; — = not analyzed.

TABLE IV-33. Southwest Drainage System, Hole 3.

Code	Lab No.	Depth	Analysis Results (µg/g)								
			Phenol	O&G	Lead	Chrome	Cad.	TOX	Copper	Cyanide	MEK
SW-03-01	8410-012-14	Surface	ND	100	96	45	4.0	7	38	ND	ND
SW-QA-01	8410-012-18	Surface	ND	170	70	40	4.0	2	33	ND	.006
SW-03-02	8410-012-16	1.5 - 2.0	ND	ND	28	25	1.0	ND	18	ND	ND

TABLE IV-34. Southwest Drainage System, Hole 4.

Code	Lab No.	Depth	Analysis Results (µg/g)								
			Phenol	O&G	Lead	Chrome	Cad.	TOX	Copper	Cyanide	MEK
SW-04-01	8410-012-22	Surface	ND	ND	42	23	0.6	1	32	ND	ND
SW-QA-02	8410-012-23	Surface	ND	ND	27	20	ND	ND	30	ND	ND
SW-04-02	8410-012-25	3.0 - 3.5	ND	ND	22	18	ND	ND	15	ND	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-35. Southwest Drainage System, Hole 5.

Code	Lab No.	Depth	Analysis Results (µg/g)								
			Phenol	O&G	Lead	Chrome	Cad.	TOX	Copper	Cyanide	MEK
SW-05-01	8410-012-21	Surface	1.1	100	88	360	1.6	1	34	ND	ND
SW-05-02	8410-012-19	3.5 - 4.0	ND	ND	21	26	ND	ND	16	ND	ND

TABLE IV-36. Southwest Drainage System, Hole 6.

Code	Lab No.	Depth	Analysis Results (µg/g)								
			Phenol	O&G	Lead	Chrome	Cad.	TOX	Copper	Cyanide	MEK
SW-06-01	8410-012-24	Surface	ND	ND	34	20	ND	ND	34	ND	ND
SW-06-02	8410-012-26	1.5 - 2.0	ND	ND	29	24	ND	ND	26	ND	ND

NA = no lab number assigned; ND = not detected; -- = not analyzed.

TABLE IV-37. Northwest Drainage System, Hole 1.

Code	Lab No.	Depth	Analysis Results (µg/g)				
			Phenol	O&G	Lead	TOX	MEK
NW-01-01	8410-012-09	Surface	ND	320	67	1	ND
NW-QA-01	8410-012-06	Surface	ND	260	72	1	ND

TABLE IV-38. Northwest Drainage System, Hole 2.

Code	Lab No.	Depth	Analysis Results (µg/g)				
			Phenol	O&G	Lead	TOX	MEK
NW-02-01	8410-012-05	Surface	ND	110	40	1	.016
NW-02-02	8410-012-07	1.5 - 2.0	ND	ND	10	ND	ND

NA = no lab number assigned; ND = not detected; — = not analyzed.

TABLE IV-39. Northwest Drainage System, Hole 3.

Code	Lab No.	Depth	Analysis Results (µg/g)				
			Phenol	O&G	Lead	TOX	MEK
NW-03-01	8410-012-08	Surface	0.7	60	29	ND	ND
NW-03-02	8410-012-11	1.5 - 2.0	ND	ND	19	ND	ND

TABLE IV-40. Northwest Drainage System, Hole 4.

Code	Lab No.	Depth	Analysis Results (µg/g)				
			Phenol	O&G	Lead	TOX	MEK
NW-04-01	8410-012-10	Surface	1.6	180	38	1	ND
NW-04-02	8410-012-12	1.5 - 2.0	ND	ND	21	ND	ND

NA = no lab number assigned; ND = not detected; — = not analyzed.

contamination is in the areas of known/reported spills. The concentrations of lead and oil and grease reach about 60 and 340 µg/g, respectively. The boring near the old fuel delivery system (LI-03) was found to be contaminated with oil and grease and lead from about 20 feet to 40 feet. Elevated oil and grease and lead levels were found at the bottom of the hole (45 feet). The locations where higher organic vapor readings were encountered during field sampling matched the locations of elevated oil and grease in LI-03.

The sample collected at the head of the southwest drainage channel was found to be contaminated with high levels of organics and inorganics. Progressively lower concentrations were found in downstream samples. Metal concentrations in SW-05 (retention pond soil) are higher than the preceding samples (SW-04). This may be caused by deposition of metals washed down the channel into the lagoon. With the exception of the two upstream sampling locations, the subsurface samples were not contaminated (in the two subsurface samples that were contaminated, concentrations were about 1/10th of their surface counterparts). The contaminated samples at SW-01 were nearly saturated with oily material.

Landfill samples were found to contain no phenol, oil and grease, TOX, or cadmium. Lead and chromium were found in all the samples, but most concentrations were found to be in the 10-to-20 µg/g range. These negative results were expected, because of the absence of organic vapor readings and moisture/staining in the soils collected.

The northwest drainage channel was found to be relatively clean. The sample taken at the head of the drainage channel had elevated levels of oil and grease and lead, but all other samples were below the background levels (for all analytes). The concentrations in the background surface sample (NW-04-01) were higher than most of the other background samples taken at other sites; however, they are not considered out of line.

Samples of the drummed drill cuttings were analyzed for E.P. toxicity and ignitability. Results are shown in Table IV-41. Cuttings from FP-08,

TABLE IV-41. Analysis of drum samples.

Sample ID	Units	Drum Samples			
		FPTA		LI-03	
		Drum 1	Drum 2	Drum 3	Drum 4
Arsenic	mg/l	<0.01	<0.01	<0.01	<0.01
Barium		0.7	0.9	0.9	0.7
Cadmium		<0.01	<0.01	<0.01	<0.01
Chromium		<0.05	<0.05	<0.05	<0.05
Lead		0.23	<0.02	10[1]	12[1]
Mercury		<0.001	<0.001	<0.001	<0.001
Selenium		<0.01	<0.01	<0.01	<0.01
Silver		<0.01	<0.01	<0.01	<0.01
Ignitability,	°C	>650	>650	>650	>650

[1]EP Toxicity limit is 5.0 mg/l

FP-09, and FP-15 were placed in drums No. 1 and No. 2. Cuttings from LI-03 were placed in drums No. 3 and No. 4. Samples from drums No. 3 and No. 4 were found to exceed the lead criteria for the E.P. toxicity test (5 mg/l in leachate). The results from all other analyses were negative.

5. Analytical Summary

AeroVironment has been able to confirm the presence of localized contamination at the fire protection training area, liquid fuels storage area, and southwest drainage system at Williams AFB. In addition, magnetometer surveys at the pesticide burial area identified several pockets of buried ferromagnetic material presumed to be drums or cans. No evidence of significant contamination was found at the northwest drainage. Analysis of landfill samples showed no abnormal organic material in the soils and only background levels of metals.

The sampling and field results did not fully determine the extent of contamination at the FPTA and LFSA. On the other hand, results from southwest drainage samples have provided a reasonably good profile of contamination at that site.

The results of soil sample analyses cannot be compared to any established standards or guidelines, because there is no guidance from federal or state environmental agencies, health/safety agencies or the Air Force. Since soil standards have not been established, it is not possible to determine exactly which samples, or soil zones, are considered to be contaminated. Additional testing of each soil unit could determine whether or not that particular zone is considered as a hazardous waste based on an EP toxicity test. However, that is both expensive and impractical. Ideally, the Air Force would be able to use a threshold value to determine what soil can be considered clean and what must be treated or removed. With soil, and especially with "group" parameters like oil and grease, a definitive comparison is not possible. Any loose interpretation of water standards established for many elements and compounds would not be applicable at Williams AFB, because the groundwater in the area is not thought to be threatened. As a result, no specific comparisons of results to standards are made in this report; only relative comparisons and professional judgments are made.

Until the groundwater has been sampled, there are bound to be questions about water quality. Groundwater monitoring wells are currently being proposed for the next IRP effort at this base. The Phase II Stage I effort was simply a soils investigation.

B. Significance of Findings

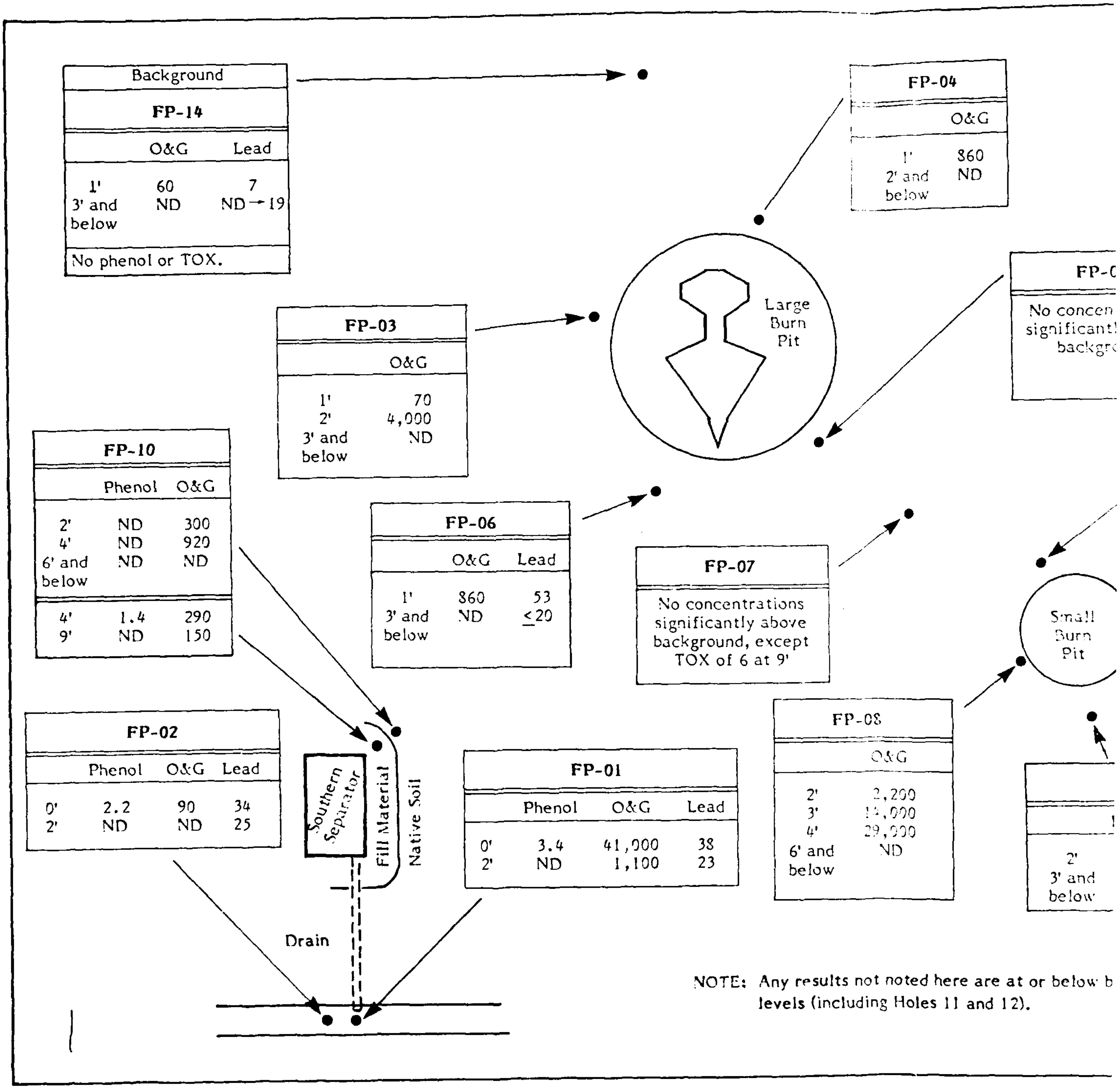
1. Possible Contamination Pathways

In general, liquid contamination (spills or leachate) will migrate downward through the unsaturated zone with some lateral spreading. The rate of this downward migration will depend on the soil type, the type of contamination, and the volume of liquid involved. The downward migration of the liquid will eventually be stopped by retention in the soils, an impermeable barrier, or the water table. If the migrating contaminant encounters a large enough volume of soil, all of the product may become pellicular and immobilized before it reaches the water table. If this is the case, the immediate problem of groundwater contamination may be averted. A further addition of more contaminant or infiltrating rainfall may reactivate the plume and continue its downward migration.

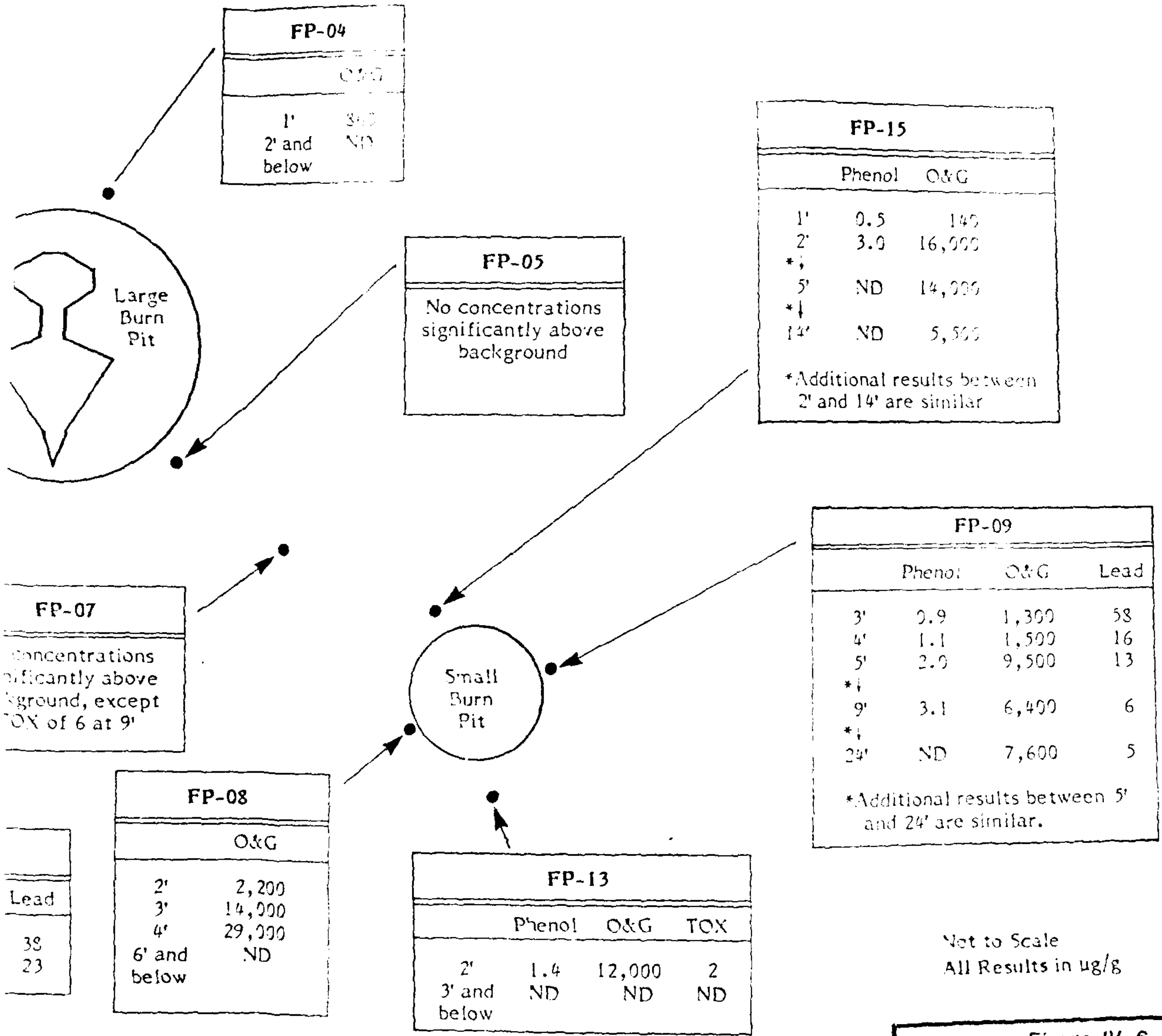
If the contaminant encounters an impermeable barrier (in this case, a possible clay layer at 70-80 feet) it will spread out along this layer in the down-dip direction until it is eventually immobilized by soil retention (specific retention). If the contaminant reaches the water table in sufficient quantities, degradation of the aquifer down-gradient is unavoidable.

2. Fire Protection Training Area

During our investigation at the fire protection training area, 15 test holes were drilled in areas of possible contamination around the site. Samples taken in 10 of the 15 holes showed soil contamination ranging in depth from 2 to greater than 25 feet from the surface (see Figure IV-6). We were able to establish an apparent lower limit of contaminated soil in all but two borings and the area of deep (greater than 25 feet) contamination appears to be limited, generally to the



Background
FP-14
O&G Lead
1' 60 7
3' and below ND ND → 19
No phenol or TOX.
FP-04
O&G
1' 860
2' and below ND
FP-03
O&G
1' 70
2' 4,000
3' and below ND
Large Burn Pit
No concen
significantl
backgr
FP-10
Phenol O&G
2' ND 300
4' ND 920
6' and below ND ND
4' 1.4 290
9' ND 150
FP-06
O&G Lead
1' 860 53
3' and below ND ≤20
FP-07
No concentrations significantly above background, except TOX of 6 at 9'
Small Burn Pit
FP-02
Phenol O&G Lead
0' 2.2 90 34
2' ND ND 25
Southern Separator
Fill Material
Native Soil
FP-01
Phenol O&G Lead
0' 3.4 41,000 38
2' ND 1,100 23
FP-08
O&G
2' 2,200
3' 14,000
4' 29,000
6' and below ND
2'
3' and below
Drain
NOTE: Any results not noted here are at or below b
levels (including Holes 11 and 12).



NOTE: Any results not noted here are at or below background levels (including Holes 11 and 12).

2

Figure IV-6
Comparison of Analytical Results at Fire Protection Training Area
Williams Air Force Base

AeroVironment Inc.

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north and east of the existing small burn pit. We have verified that at least 450 yd^3 of contaminated soil exists at this site and we are certain that this number will increase as more borings are drilled to delineate the actual areal extent of contaminated soil. Five test borings showed no detectable contamination, so it is evident that the problem is indeed localized.

From the information presented earlier in this section, the question of the extent of contamination in the fire protection training area has three possible answers. They are, in order of probability, as follows:

1) The volume of fuel that was not burned and was allowed to percolate into the ground was small enough that it was immobilized within the interstitial pores in the soil and did not penetrate over 30-50 feet vertically.

2) The volume was large enough to reach the perched water table (if it was unrestricted), but the clay found at the landfill is also present under the FPTA and the contaminant was effectively immobilized by soil retention as it spread along the clay surface. There is a good probability that the clay is present, but further drilling would be required to confirm this.

3) The volume was large enough to reach the perched water table; there was no intervening clay; and the aquifer is potentially degraded. This is highly unlikely because of the large volume of unburned fuel that would be needed. By using American Petroleum Institute (API) figures of "typical" soil porosity of 30% (API, 1972) and a specific retention value of 10% (percentage of total porosity of soil) for light oil and gasoline, a column of soil with a surface area of 315 $feet^2$ (25-foot equilateral triangle) and a depth of 200 feet (depth to water) would immobilize 14,000 gallons of unburned fuel.

During our field program at Williams AFB, a test burn was staged at the large lined fire pit. When the fire was extinguished, an excess of water and

flammable liquid remained both inside and outside the fire ring. The liquid outside the ring appeared to be caused by a combination of overfilling the liner and sloppy initial application. Windy conditions at the site also appeared to contribute to the problem. The total volume of the flammable liquid that reaches the soil outside the fire ring is unknown. This liquid was allowed to evaporate or percolate into the ground. Because of the arid climate at Williams AFB, evaporation probably removes all the water from the soils, either by direct evaporation or capillary movement of soil water back to the surface after infiltration. However, the regular application of new contamination (product) and water acts as a hydraulic driver (which does not naturally exist) and could cause deeper soil contamination. This unnatural driving force is probably responsible for existing contamination.

3. Liquid Fuels Storage Area

Contamination discovered at the LFSA in this study was localized and for the most part shallow. We drilled eight test holes, and twice found contaminated soils down to about four feet in areas of known surface spills. This level of contamination is not considered to be a serious problem since it is very shallow and localized (see Figure IV-7). The reported concentration of 80 µg/g oil and grease in the bottom background sample (LI-09-05) is considered to be suspect. There is no way to explain the test result.

The major problem at the LFSA was encountered during the test boring placed inside the fenced compound at the underground fuel storage tanks (Building 548). We extended boring LI-03 down to 45 feet and were unable to find the lower extent of contaminated soil at that location. Laboratory analyses of the soil showed very high lead concentrations (in addition to phenol and oil and grease), indicating that the soil was contaminated by leaded AVGAS instead of nonleaded JP-4 that is currently being used at the facility. The best records available at this time indicate that AVGAS has not been used since 1960 or 1961. About the same time, an old fuel delivery system and one of the underground storage tanks (Tank 11) were abandoned (Figures IV-8 and IV-9). By using plans for modifications of the fuel delivery system, we have determined that approximately 3,600 feet of four- and six-inch pipe, as well as the tank, were cut and abandoned in place. Air

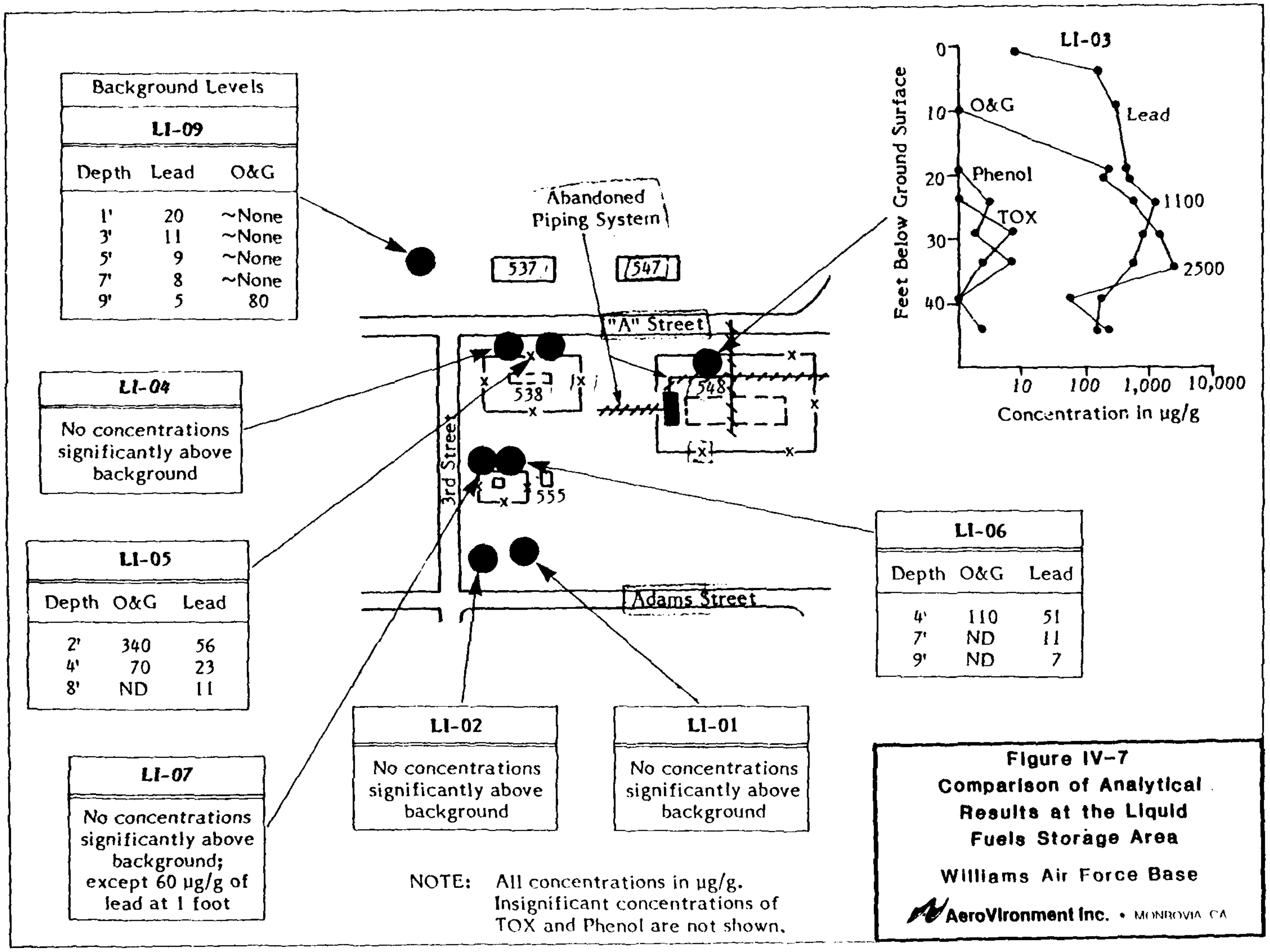
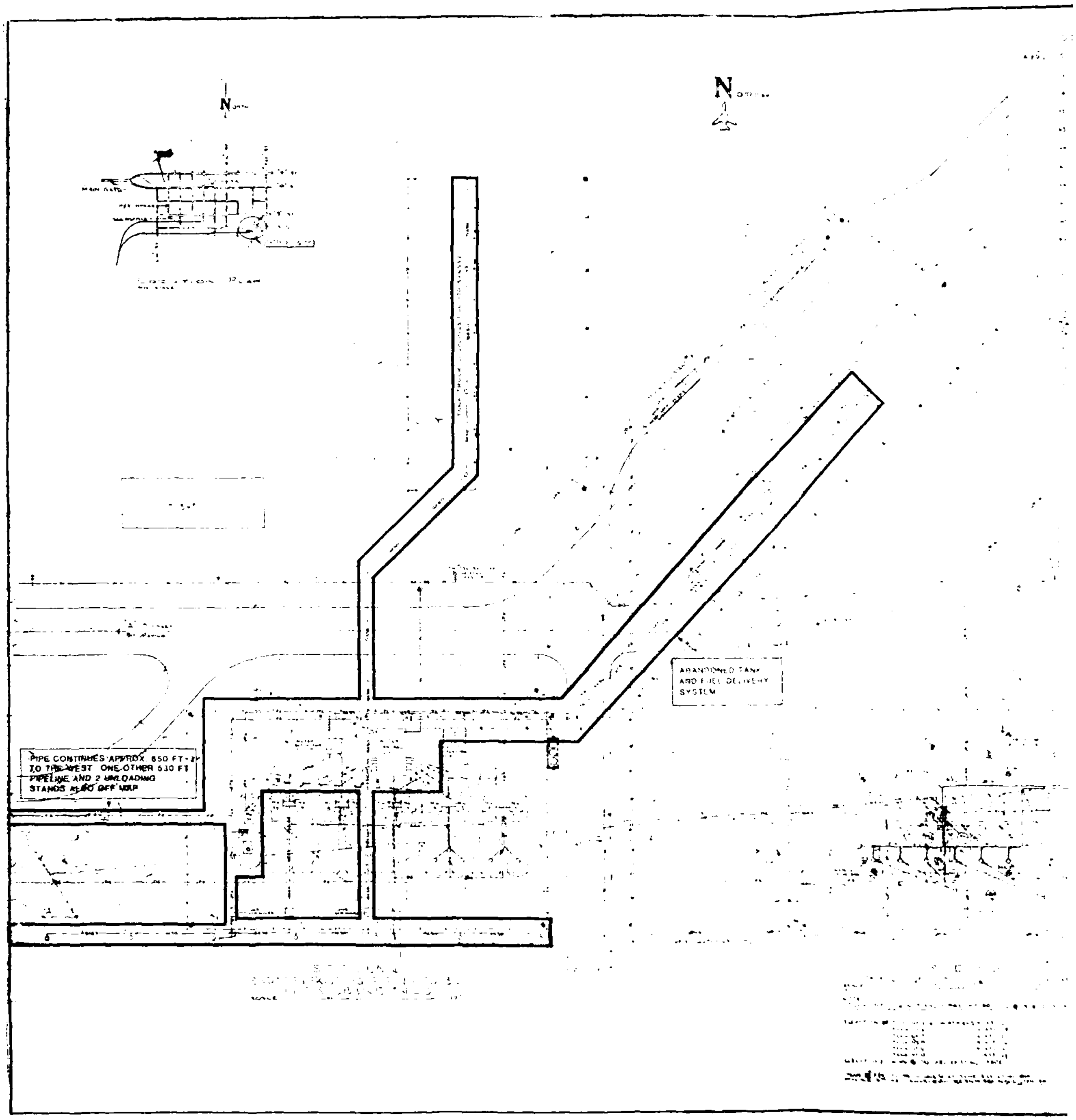


Figure IV-7
Comparison of Analytical Results at the Liquid Fuels Storage Area
Williams Air Force Base

December 1984



N
N
PIPE CONTINUES APPROX. 650 FT TO THE WEST. ONE OTHER 530 FT PIPELINE AND 2 UNLOADING STANDS ALSO OFF MAP
ABANDONED TANK AND FUEL DELIVERY SYSTEM

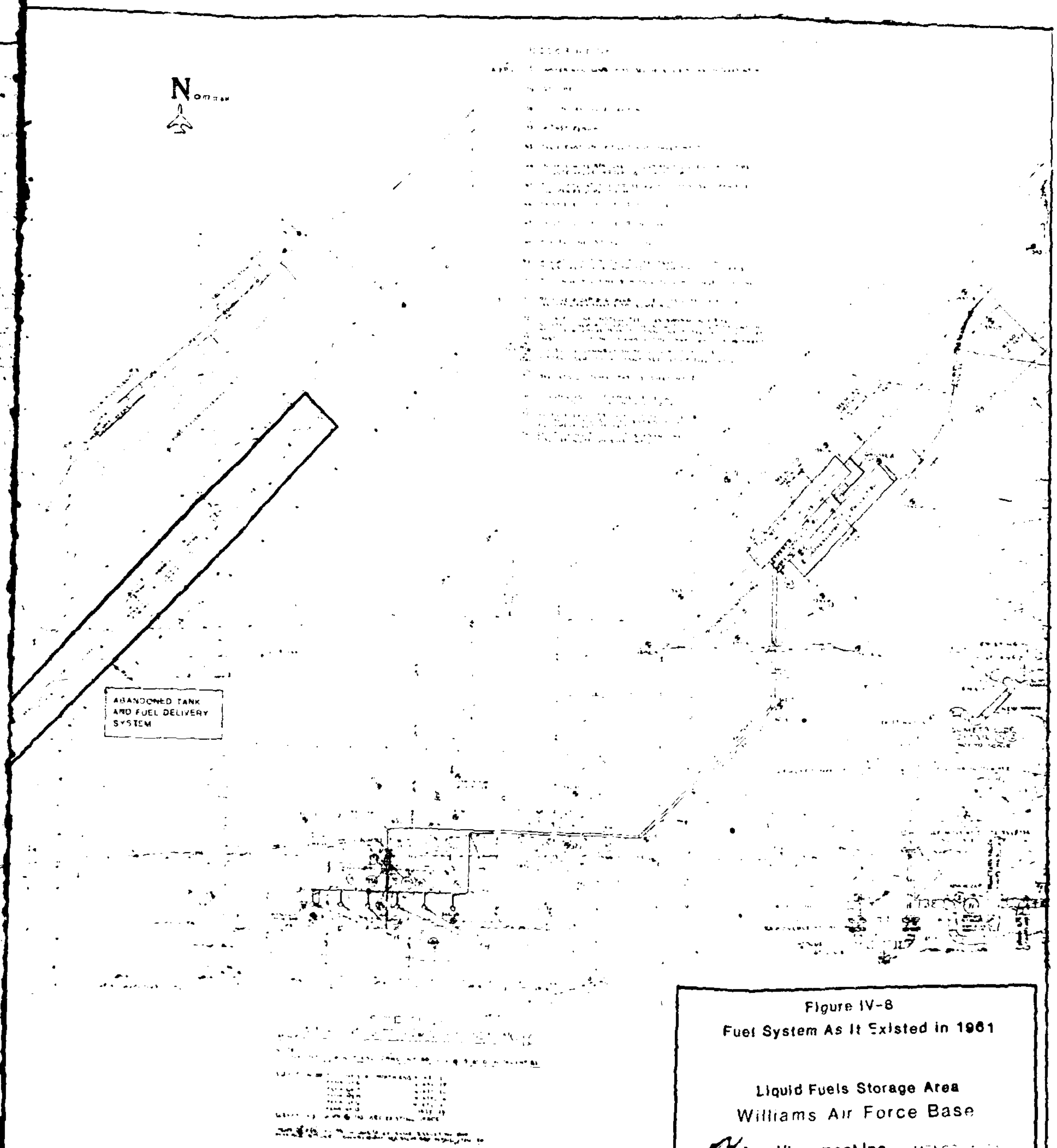


Figure IV-8
Fuel System As It Existed in 1961

Liquid Fuels Storage Area
Williams Air Force Base

AeroVironment Inc.

December 1984

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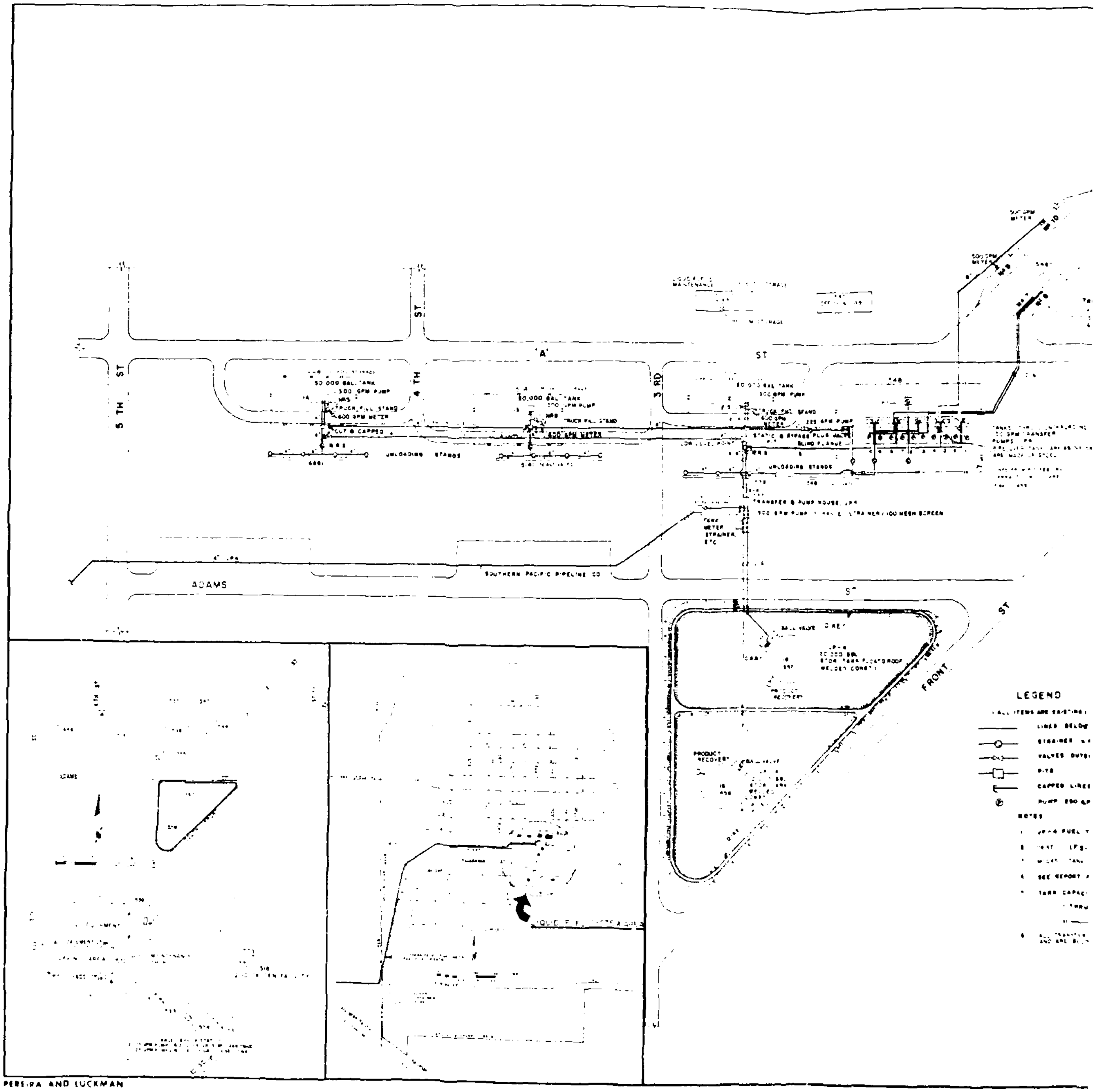

PEREIRA AND LUCKMAN

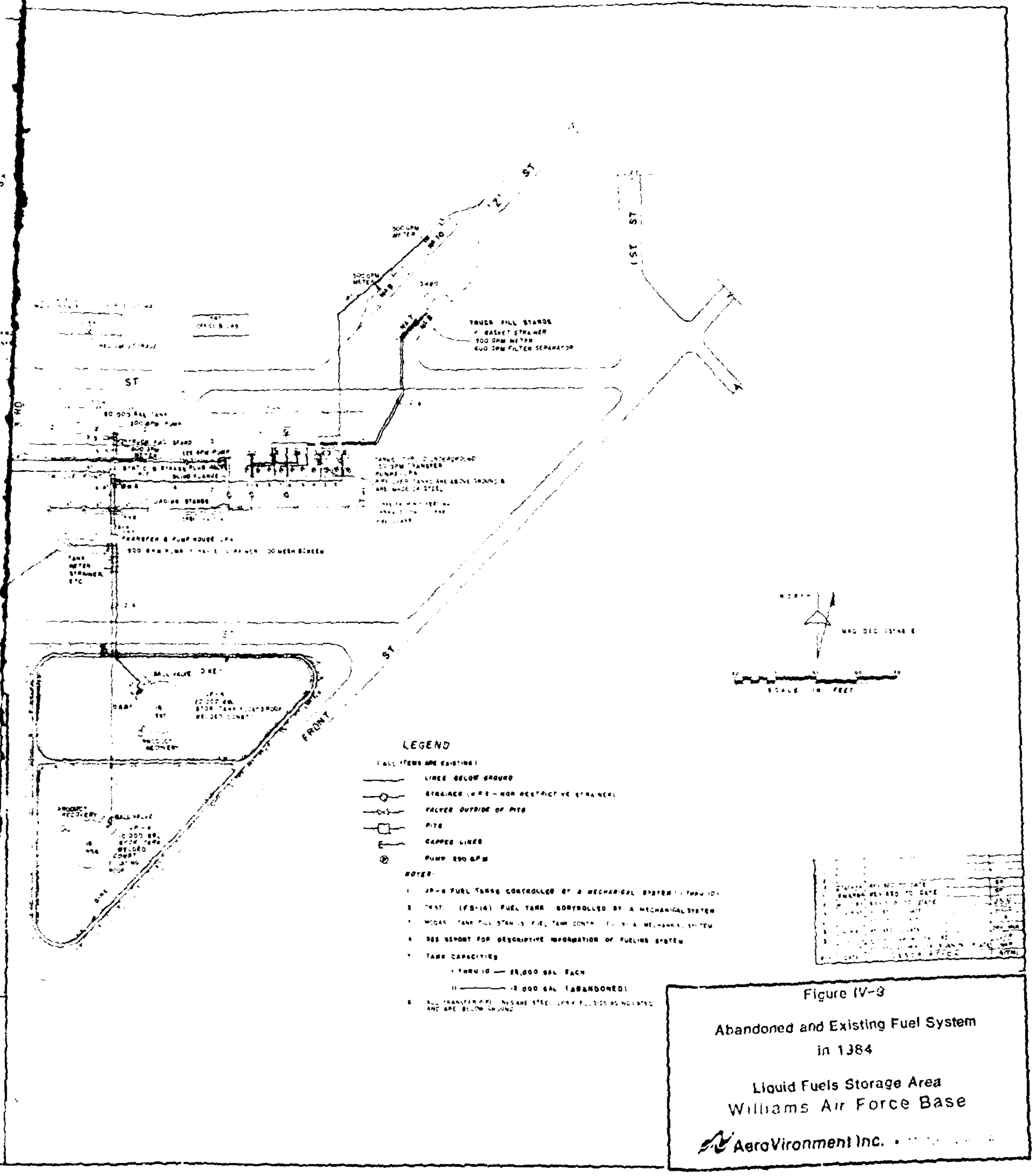

Figure IV-8

Abandoned and Existing Fuel System in 1984

Liquid Fuels Storage Area
Williams Air Force Base

AeroVironment Inc.

December 1984

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Force personnel estimate that the pipes were fully charged and the tank was pumped as empty as possible prior to closure (Mr. Petross, personal communication). The tank was filled with sand before it was abandoned.

By calculating the inside diameters of the pipe left in the ground, we estimate that a maximum of 4,400 gallons may have been left in the system at the time it was abandoned. This estimate assumes that the 12,000-gallon tank was empty. This estimate only considers pipes that were shown as AVGAS pipes to be abandoned in the renovation plans. Water pipes for the aqua-system were not included nor were any pipes which were converted to carry JP-4.

It must be assumed that the abandoned pipes, installed around 1941, have lost their ability to contain fuel. Pipeline leaks in the past have shown that fuel usually migrates through the backfill around the pipe. These backfilled excavations are usually filled with more permeable material than native soil, and thus offer a prime migration route. The fuel will quite often collect in the lowest portion of the trench and percolate into the native soil at that point. At Williams AFB, the surface gradient is so slight that it is unlikely that the pipe trench had a definitive "lowest point." Most likely, once the backfill was saturated, percolation took place at many points along the bottom and sides of the trench. The soil around the liquid fuels storage area generally has thin zones of caliche anywhere from 8 to 12 feet. These zones are relatively porous, not continuous over the entire area, and should not greatly inhibit the movement of fuel through the soil.

Using API figures for specific retention, we estimate that the 4,400 gallons of fuel that may have remained in the abandoned pipeline could be immobilized by approximately 725 yd^3 of soil. Based on this estimate, the fuel has had little chance of reaching the perched water at 200 feet.

However, the analytical results of samples taken from boring LI-03 indicate that the contaminants are not at their "specific retention" concentrations and are vertically spread over 20 to 30 feet. This finding would indicate that substantially more than 725 yd^3 of soil are affected. Additionally, leaks may have caused problems even before the old AVGAS lines were decommissioned. The

problem with making estimates based on only one boring is that we do not know whether that boring is representative of the overall problem. In particular, LI-03 was placed near an old sump and several pipes; thus, it may be a worst-case situation. In addition, no information is available on the other two dimensions. Therefore, we did not use the LI-03 samples as the sole basis for estimating the volume of soil contamination. But it appears that LI-03 contains at least a pocket of contaminated soil.

The soil volume estimates calculated here are intended to give an order of magnitude of the problem. We know of about 3,600 feet of abandoned fuel line in about 2,400 feet of trench (some trenches carry two to three pipes for certain distances). If we assume that a cross-section of 16 $feet^2$ is contaminated over the entire length of the trenches, then a total volume of 38,400 $feet^3$ (1,425 yd^3) of soil would be contaminated. Again, there is no way of knowing whether these assumptions are valid without further soil sampling (LI-03 alone would indicate that they are too low). However, the problem could be this extensive.

4. Southwest *Drainage* System

The southwest drainage has two distinct zones of contamination (see Figure IV-10). The first, and most contaminated, is located from the pipe outfall to approximately 50 feet down channel. The soil in this area is extremely contaminated, but the volume of highly contaminated soil is small, about 12 yd^3.

The second reach of channel, 50 feet to about 850 feet from the outlet pipe, has slight to moderate contamination. This area is much larger, but the depth of contaminated soil decreases along the channel, so the estimated volume of contaminated soil in this area is only 90 yd^3. The remainder of the channel appears to be free of significant soil contamination. Due to the very small volume of highly contaminated soil, degradation of the perched groundwater from this site is considered unlikely.

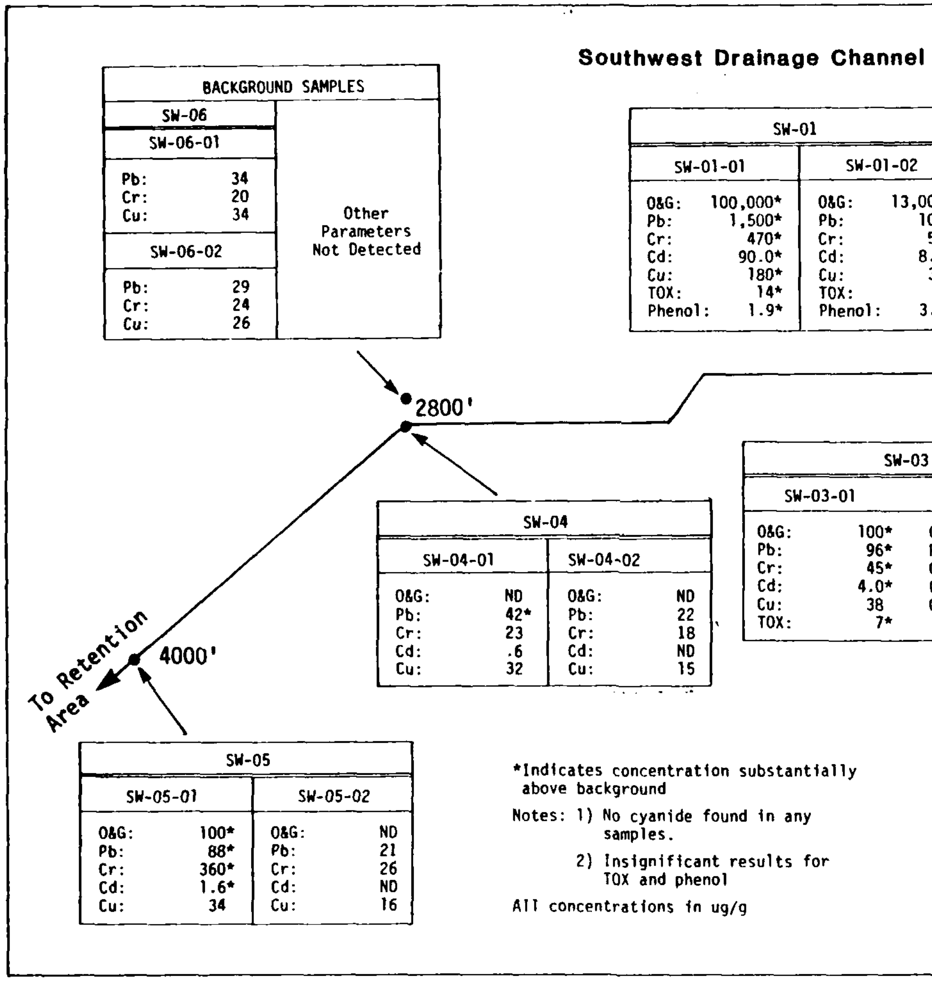


Figure IV-10
Comparison of Analytical Results from Southwest Drainage Channel
Williams Air Force Base

AeroVironment Inc. MONROVIA, CA

December 1984

The upper reach of the southwest drainage channel presents a potentially serious health threat. The surface sample at the pipe outlet was found to contain 10% (100,000 µg/g) oil and grease. In addition, toxic metals (lead, chrome and cadium) were found at highly elevated levels. The location of the contamination is a prime factor in its degree of threat to health. First, these are surface soil conditions. Second, base housing facilities are located directly across 5th Street (50-100 feet). This presents a real exposure potential for individuals, especially children who would come in direct contact with this soil (no organic vapors were found during air monitoring).

The potential health threat to on-base personnel, especially children, is considered the most significant finding of this program.

5. *Landfill*

The landfill has very little chance of causing groundwater contamination problems for three reasons:

1) Arid conditions at the site will inhibit leachate formation by removing the hydraulic driving mechanism.

2) The volume of hazardous chemicals placed in the landfill is assumed to be very small when compared to the landfill "sponge" material. This sponge material also probably has a very low moisture content (approximately 20%), which would further inhibit leachate formation (Tchobanoglous, 1977). Rough calculations using methods specified in EPA publications have also indicated the potential for leachate generation in the landfill to be very small (EPA, 1975).

3) We have confirmed the existence of a clay layer at 70-80 feet by drilling to that layer four points around the landfill. Any leachate or contaminated water percolating through the landfill cavity should be found in the sand and gravel ("marker gravel") immediately overlying the clay. None was found.

Analytical results from landfill samples may be found in Figure IV-11. No abnormal organic material was found. Metals were found, but not substantially above normal soil concentrations in the landfill area.

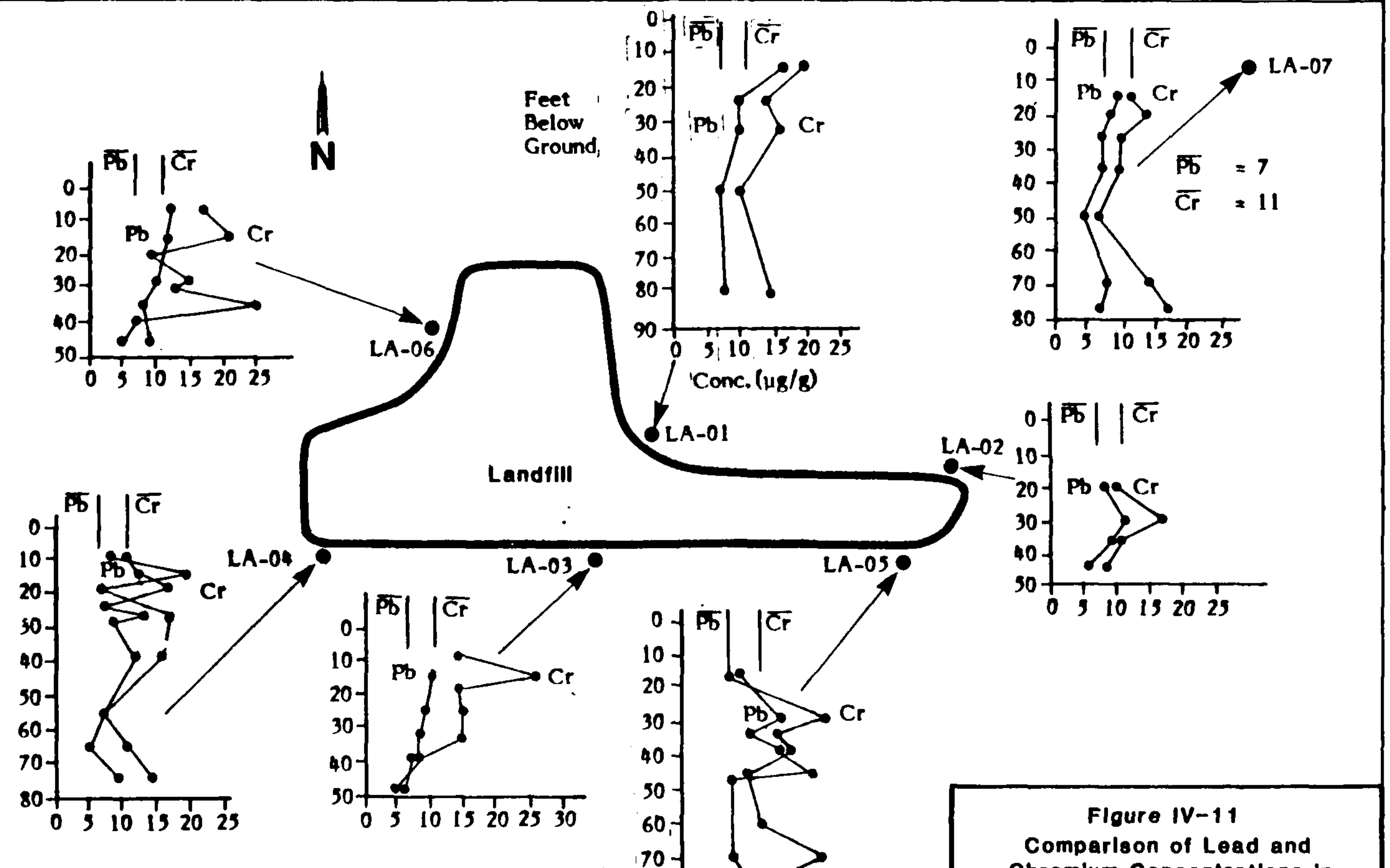
6. Pesticide Burial Area

Because the October 11, 1984 magnetometer survey does not show the interference from the metal signs, interpretation will focus on that data set. Figure IV-12 shows a contour map of the October 11, 1984, data, divided into four anomaly regions labeled 1, 2, 3, and 4. The depth (depth to center) and location (location of center) of the bodies interpreted to cause the anomalies are also shown.

In Region 1, two anomalies appear. The anomaly centered at (J5,50) is a textbook example of a south-positive, north-negative induced magnetic anomaly. The high amplitude and the north-south elongation of this anomaly suggests more than one body may be present. The anomaly centered at (K,20) is somewhat unusual. The positive amplitude is extremely high (+700 gammas) and the corresponding low is weak. This pattern is often indicative of a buried vertical pipe (well casing), but can also be caused by several drums stacked on top of each other.

Three anomalies are present in Region 2 and are centered at (H5,85), (H,75), and (H,60). The centers of the bodies causing these anomalies are grouped close together and have similar depths. It is possible that two or all three of these anomalies are part of one large burial site. The (H+5,85) anomaly has a very large amplitude and may consist of multiple 55-gallon drums.

Magnetic highs dominate Region 3. It is possible that a number of small canisters are buried within this region, causing the high background values and eliminating the expected magnetic lows. The highest amplitude anomaly in this region is centered at (D+5,25) and may consist of several 55-gallon drums. The anomaly centered at (D+5,50) is the anomaly closest to a reported burial site, estimated at (E,70), where rusty containers were encountered four feet beneath the



Notes: 1) $\overline{Pb}$ and $\overline{Cr}$ are mean concentrations of lead and chromium in background hole (LA-07).

2) No phenol, oil & grease, cadmium or TOX were detected in any of the landfill samples.

Figure IV-11
Comparison of Lead and Chromium Concentrations in Landfill Samples
Williams Air Force Base

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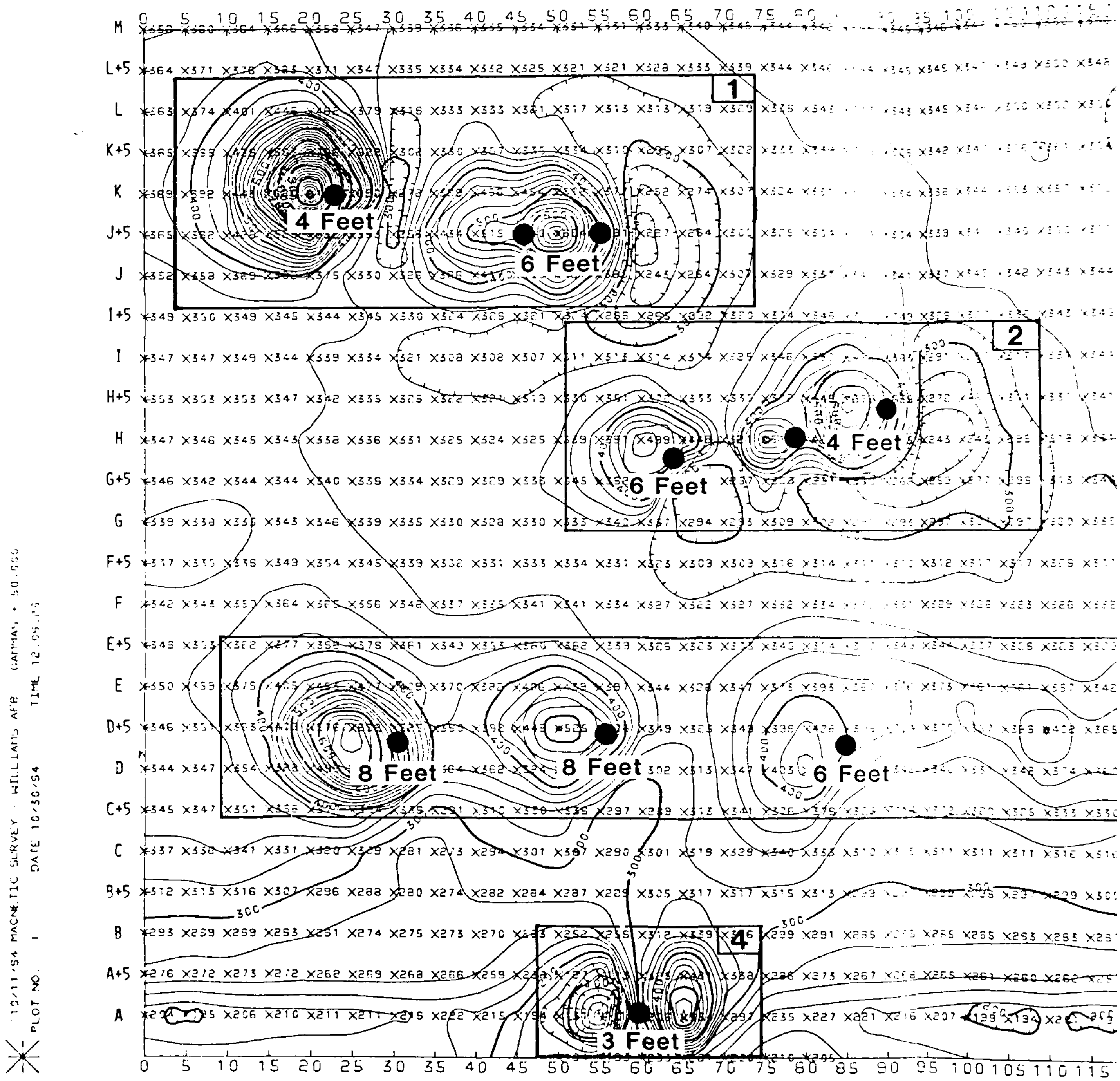
MAGNETIC SURVEY - WILLIAMS AFB
PLOT NO.
DATE 10/30/84
1
4 Feet
6 Feet
2
6 Feet
4 Feet
8 Feet
8 Feet
6 Feet
4
3 Feet

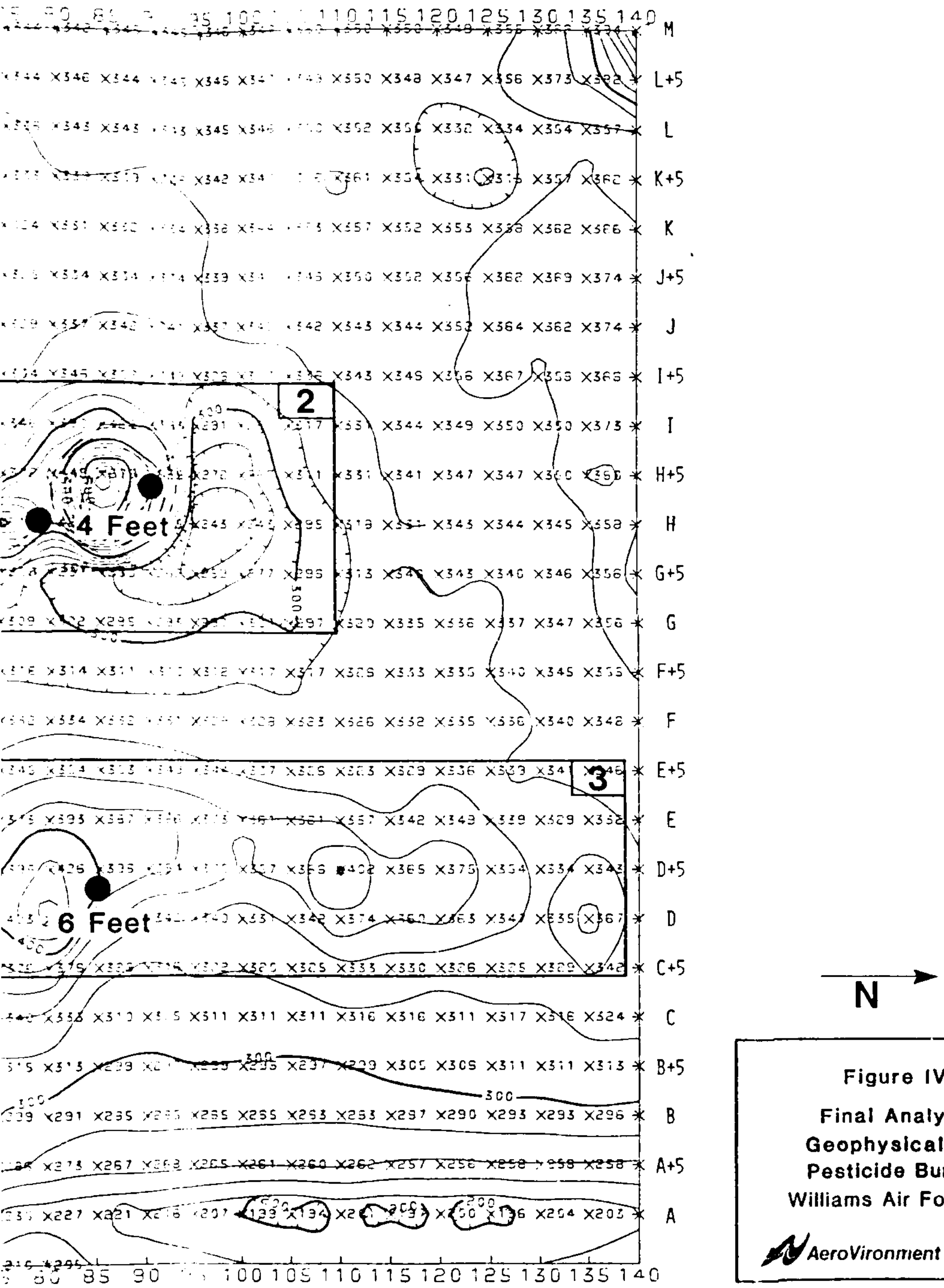

Figure IV-12

Final Analysis of Geophysical Survey Pesticide Burial Area Williams Air Force Base

AeroVironment Inc. MONROVIA CA

December 1984

surface. The anomaly centered at (D,80) has a relatively low amplitude in comparison to the previously discussed anomalies, but may still be large enough to consist of one 55-gallon drum or several 10-gallon containers. North of this anomaly, the magnetic highs may be caused by a regional peak or the presence of small containers. The anomaly pattern at this location is not definitive.

The anomaly of Region 4 is somewhat puzzling. The south-positive north-negative pattern is reversed. This pattern indicates remanent magnetization dominates the induced component. Bodies struck by lightning, placed in a strong magnetic field, or containing magnetite often have a large remanent field. The depth and location interpretation for this anomaly is tenuous, because the induced field assumption is violated.

7. Northwest Drainage System

No significant contamination was encountered in the northwest drainage system. The mean oil and gas concentrations for the three borings in the channel was actually lower than that of the background boring outside of the channel (Figure IV-13). This may indicate that oily material from automobiles in the housing areas and roadways has as great an effect as the flight line drainage.

There is no perceived threat to the Roosevelt Canal, which is the off-site receiving stream for the northwest drainage system.

8. Cuttings Samples

The results of E.P. toxicity tests on the four drum samples indicate that drums No. 3 and No. 4 are hazardous. Both of these samples exceed the allowable concentration of lead in the leachate. Drum No. 3 contained 10 mg/l and drum No. 4 contained 12 mg/l in the leachate solution. The standard is 5 mg/l. Both drums will have to be disposed of as hazardous waste. Drums No. 1 and No. 2 can be handled in any manner the Air Force considers appropriate.

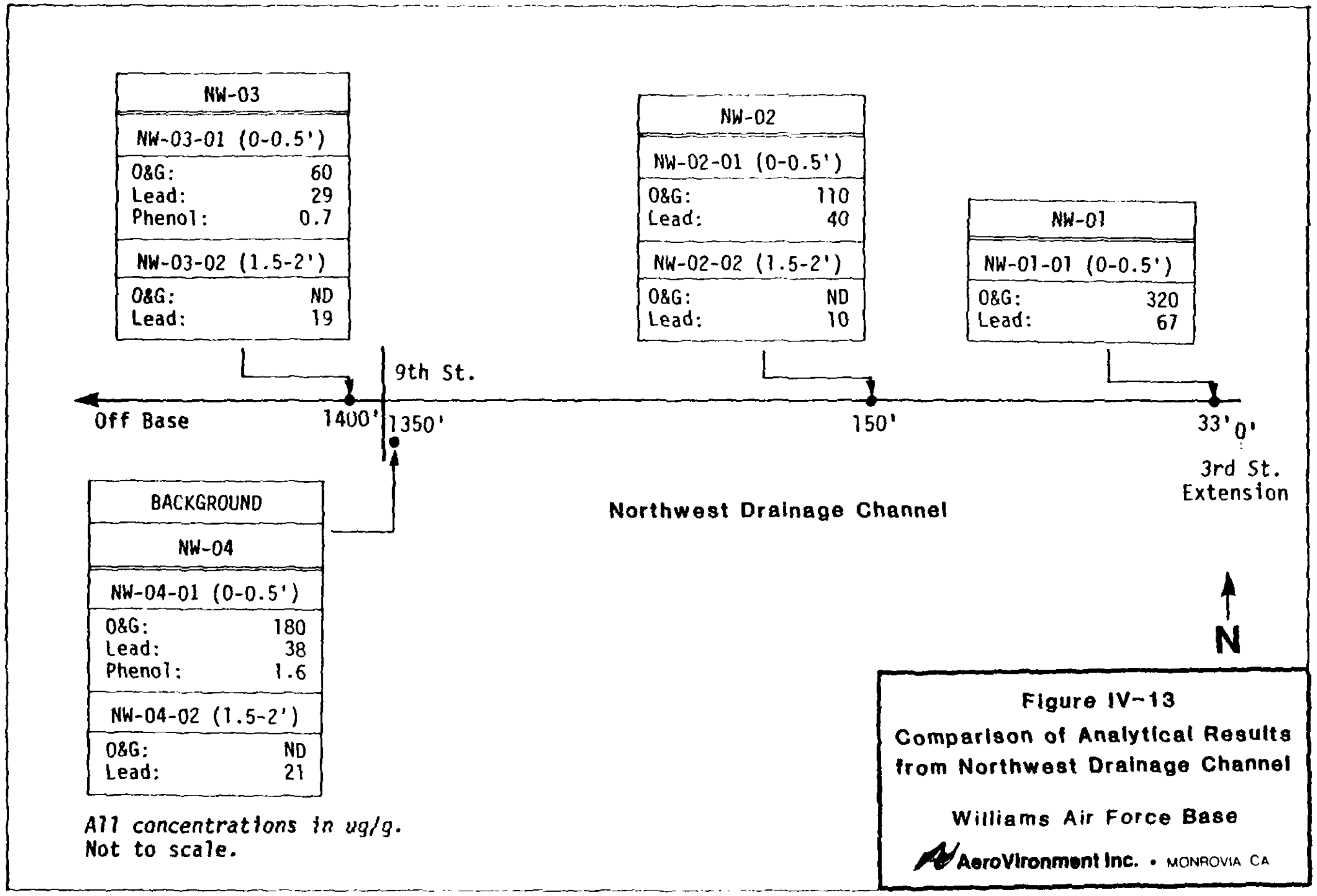

Figure IV-13
Comparison of Analytical Results from Northwest Drainage Channel

Williams Air Force Base

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9. General Conditions

To this point, all discussions of possible contamination of groundwater supplies beneath Williams AFB have centered on the perched aquifer found about 200 feet beneath the surface. Beneath the perched aquifer, and separated from it by an aquiclude of indeterminate thickness and other sediment more than 200 feet deep, is the artesian aquifer tapped by the deep wells in the area. In general, due to the upper perched zone, this aquifer is immune from contaminants percolating from the surface. The recharge zone for the deep aquifer is probably in the alluvial fans at the base of mountains many miles from Williams AFB.

There is a theoretical possibility that the confined aquifer could be contaminated by leachate or fuel spills from Williams AFB. In order for this to happen, quite a few conditions would have to be met:

1) The perched aquifer would have to be contaminated from the surface.

2) The plume of contaminated water would have to intersect a well that was perforated in both the perched and confined aquifers, giving the polluted water a direct pathway down into the deep aquifer.

3) During periods when the well was not being pumped, contaminated water would need to drain down the well and into the confined aquifer which has a lower head pressure.

This situation is considered to be a remote possibility.

V. ALTERNATIVE MEASURES

Six sites at Williams AFB were investigated for the presence of chemical contamination during this study. Two of these sites, the landfill and northwest drainage system, do not warrant any additional investigation or remedial activity. The southwest drainage system and the pesticide burial area were found to be contaminated and the extent of that contamination is thought to be well defined. The other two sites investigated, the fire protection training area and the liquid fuels storage area, were found to contain localized areas of contamination; however, in Stage I of the Phase II study, we were unable to fully define the lateral or vertical extent of migration.

This chapter discusses in terms of this Stage I study the actions which can be taken at each of the six sites. The discussion will concentrate on feasible alternatives, presenting only practical and cost-effective activities. At least two options are available to the Air Force at each site. Recommendations are made by AeroVironment in the following chapter, but the USAF will need to judge the overall merits of each option to determine whether it meets the safety, economic and environmental policy goals of the USAF. The sites are discussed in the order of their priority before the start of this study.

A. Fire Protection Training Area

Laboratory analysis of soils collected at the FPTA show that the historic practice of burning waste fuel has created localized soil contamination. Generally, contamination is limited to surface soils ranging in depth from 0 to 2 feet. Deeper contamination was found in fill material around the southern separation pit (boring FP-10) and around the small burn pit (boring FP-09 and FP-15).

The surface contamination (oil and grease) is probably the result of spills and poor housekeeping. This surface contamination is not a threat due to the arid climate at Williams. The deep contamination (down to at least 9 feet) around the separator was not found in highly elevated concentrations and is probably

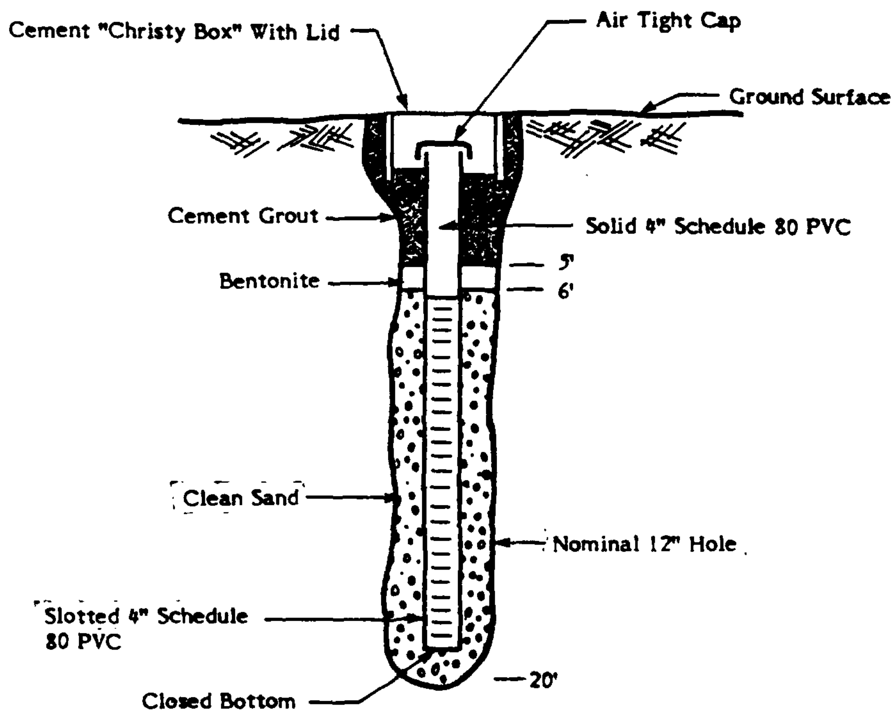
limited to the fill around the concrete pit. Although concentrated oil and grease levels were found in the drainage channel (FP-01 and FP-02), that area is extremely small and contamination is limited to a depth of about 2 feet. The conditions under the small burn pit indicate that a potential problem exists or could develop. AV's sampling identified two boring locations with highly elevated concentrations of oil and grease, and, in certain samples, phenol and TOX. Borings FP-09 and FP-15 were advanced to 24 and 14 feet, respectively, but did not reach the lower extent of the soil contamination. Although unlikely, the contamination could extend significantly deeper. Because the area of the small burn pit was used for many years without any liner, the full impact is unpredictable. Also, with only two borings in the problem area, the areal extent of the contamination cannot be fully determined. Two borings located 20 feet to the southwest showed only surface contamination, but no samples were collected north or east of FP-09 and FP-15.

Possible follow-on activities at the FPTA include

1) No action -- If the USAF feels that the problems at the FPTA are sufficiently localized that deep soils and groundwater are not threatened, this alternative would be appropriate. Only limited human activity occurs at this site.

2) Additional drilling and soil sampling around the fire pits -- This activity would fully define the extent of contamination in three dimensions so the magnitude of soil contamination under the two fire pits could be fully understood.

3) Installation of permanent vapor monitoring wells -- These wells could be placed in borings from the Stage II sampling program located at the outside edge or below the zone of contamination (see Figure V-1). Gases sampled from these wells would be monitored for indications of lateral or vertical movement of contamination.



*Note: Do not join pipe with glue;
use threaded joints.

Figure V-1

Typical Vapor Monitoring Well

Williams Air Force Base

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December 1984

4) Deep drilling to look for a continuous clay layer -- The advancement of two or three borings to a depth of 85-100 feet would determine whether the clay layer found under the landfill is continuous under the FPTA. If the clay layer is found, and no contamination is found directly above it, the risk of further vertical migration to groundwater would be low.

5) Placement of a monitoring well in the perched water table -- This action would allow groundwater sampling from below the FPTA, which could provide definitive information on the condition of groundwater beneath the site (see Figure V-2).

B. Liquid Fuels Storage Area

Most contamination at the liquid fuels storage area was found in surface soils at historic fuel spill locations. Levels up to 340 μg/g of oil and grease and 60 μg/g of lead were found in the top four feet of soil. No evidence was found of downward migration of contamination from spills.

During the investigation of the LFSA, AeroVironment identified a potential problem which had not previously been addressed at this site. While drilling to assess the effects of a JP-4 leak at facility 548, we found high levels of oil and grease and lead. Phenol and TOX were found at levels above background, but are not considered significantly elevated. The high levels of lead (up to 1,000 μg/g) indicated that AVGAS, not JP-4, was probably the source of contamination. Later in the field program, USAF fuels management personnel found a map showing an AVGAS fuel delivery system which was abandoned in 1961. AV's boring LI-03 had been drilled within five feet of piping in that system. Soil samples taken from LI-03 were found to have oil and grease concentrations up to 2,500 μg/g and phenol and TOX up to about 8 μg/g. Laboratory results indicate that the bottom of the contamination zone is probably just below the bottom of the boring, which was terminated at 45 feet. This is suspected because the concentrations of contaminants at 45 feet are substantially below the peak concentrations found at 25-35 feet. However, there is no way to confirm this suspicion during this stage.

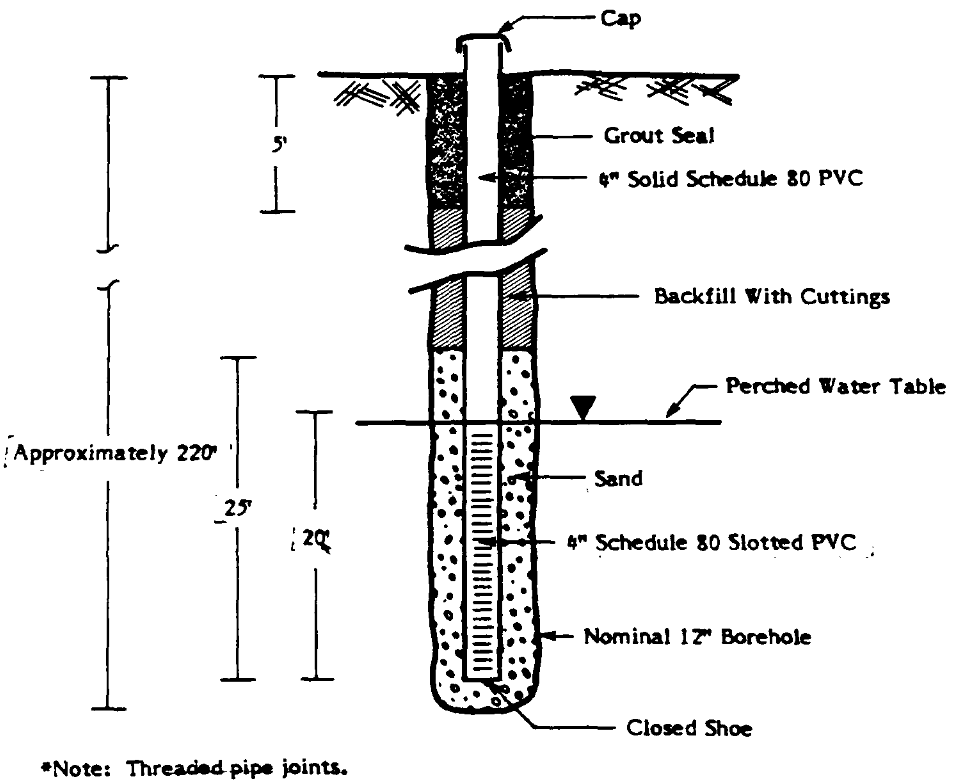


Figure V-2

Typical Deep Piezometer

Williams Air Force Base

AeroVironment Inc. MONROVIA CA

December 1984

Possible follow-on activities at LFSA include

1) No action -- If the Air Force feels that the problems at the LFSA are sufficiently localized that deep soils and groundwater are not threatened, this alternative would be appropriate. Only limited human activity occurs at this site.

2) Additional drilling and soil sampling along the abandoned AVGAS system -- This activity will help define the extent of the problem around the abandoned pipes. In particular, drilling would determine the lower extent and the lateral extent (perpendicular to the pipe) of contamination, and would determine whether contamination exists along the entire length of the system.

3) Installation of permanent vapor monitoring wells -- These wells could be placed in borings from the Stage II sampling program located at the outside edge or below the zone of contamination (see Figure V-1). Gases sampled from these wells would be monitored for indications of lateral or vertical movement of contamination.

4) Deep drilling to look for a continuous clay layer -- The advancement of two or three borings to a depth of 85-100 feet would determine whether the clay layer found under the landfill is continuous under the LFSA. If the clay layer is found, and no contamination is found directly above it, further vertical migration to groundwater could be considered improbable.

5) Placement of a monitoring well in the perched water table -- This action would allow groundwater sampling from below the LFSA, providing definitive information on the condition of groundwater beneath the site (see Figure V-2).

C. Southwest Drainage System

Highly concentrated levels of both organic and inorganic compounds were found in soils at the head of the southwest drainage. Sample SW-01-01 was found to contain 10% oil and grease and 0.2% toxic metals. Contaminant concentrations in the southwest drainage system dropped off rapidly with depth into the soil and distance downstream from the drainage head. The upper reach of the stream contains soil considered to be a threat to the surrounding environment. Particular concern is raised at this site because of the close proximity to base housing and the resulting potential for human contact.

The Stage I sampling has generally defined the level of contamination along the centerline of the drainage channel from its head to the retention pond into which it empties. However, only one sample was collected in the retention pond and the lagoon may serve as a collection point for metal compounds which have washed down the channel over the life of the base. Immediate remedial action is deemed appropriate at the southwest drainage and will be discussed in Chapter VI.

Possible follow-on activities for Stage II at the southwest drainage system include

1) No action -- This option should be taken if no additional sampling or investigation is needed to develop a remedial activity plan for this site, or if no serious environmental threat is envisioned (with or without the remedial activity).

2) Additional sampling at the head of the channel -- This activity would provide additional information on the three-dimensional extent of the heavily contaminated area along the first 50 feet of the system.

3) Additional sampling along the lower reach of the southwest drainage -- This activity would further define the depth and width of contamination

within the channel and investigate the possible deposition of contaminants in the retention pond.

D. Landfill

Sampling at the landfill indicated that no organic or inorganic contamination exists in the soils bordering the fill area. Only near-background levels of lead and chromium were found in any of the samples analyzed. Our drilling confirmed the presence of a clay layer at a depth of 80-85 feet under the landfill. This layer is thought to be continuous.

No samples were collected directly in the fill or below the fill material, so no conclusions can be drawn about the presence or absence of contamination below the buried wastes. Any vertical migration of contaminants from buried waste would not have been detected by our sampling program. However, the presence of the clay layer below the landfill would provide a barrier to trap contaminants in the soils above the clay. If contamination has migrated to the clay layer, the contaminants would spread out along the top of the clay and could be detected at locations along the outer edge of the fill. No contamination was found in the soil samples taken above the clay layer.

Possible follow-on activities at the landfill include

1) No action -- This option would be exercised if the Air Force feels that no threat of environmental degradation exists at the landfill.

2) Additional drilling and sampling through the landfill material -- More conclusive information could be gathered on leachate formation and movement directly below the fill. We understand that USAF policy does not currently permit this type of activity.

3) Placement of a monitoring well in the perched water table -- This action would allow groundwater sampling from below the landfill, which could provide definitive information on the condition of groundwater beneath the site.

E. Pesticide Burial Area

A magnetometer survey of the pesticide burial area identified ten potential burial locations, all at depths of approximately 5 feet. No sampling or drilling activities were conducted at this site. Previous studies recommended excavation of any material identified in the Phase II study. That recommendation is still valid for this site, based on survey findings, and will be discussed in Chapter VI.

Possible follow-on activities for Phase II at the pesticide disposal area include

1) No action -- This option would be appropriate if the Air Force determines that the limited amount of waste buried poses no serious threat to the environment.

2) Drilling and sampling near identified magnetic anomalies -- A drilling and soil sampling program would be conducted to determine whether there is any pesticide contamination in the soils surrounding the suspected burial locations.

3) Installation of permanent vapor monitoring wells -- These wells could be placed in borings from the sampling program located at the outside edge or below the suspected zone of contamination. Gases sampled from these wells would be monitored for indications of lateral or vertical movement of contaminants.

Excavation of the buried materials at the pesticide burial area is not considered a follow-on activity for IRP Phase II. It would be part of a clean-up activity in Phase IV. The recommendation for excavation is discussed in Chapter VI.

F. Northwest Drainage System

The northwest drainage samples showed no significantly elevated levels of any of the contaminants under analysis. As in the southwest drainage, the highest concentrations were found at the head of the channel where runoff exists at the piping system. However, unlike the southwest drainage case, these highest concentrations were only 320 µg/g for oil and grease and 67 µg/g for lead. The head of the northwest drainage channel is not near base housing and all the other samples from this site were below background concentrations.

The background surface sample had greater concentrations of oil and grease than background samples from the other four sites investigated during this project. The background sample was taken from a tributary ditch which drains portions of the northern base housing complex. The elevated oil and grease levels may be caused by automobile-related hydrocarbon runoff from the housing area.

Possible follow-on activities at the northwest drainage system include

1) No action -- This option would be selected if the Air Force determines that the northwest drainage system presents no serious threat to the surrounding environment.

2) Additional sampling along the channel -- This activity would provide more information on the level of contamination in three dimensions: a) at depth, b) along the channel length, and c) outward from the centerline of the channel.

APPENDIX A

Definitions

A. DEFINITIONS, NOMENCLATURES AND UNITS OF MEASUREMENT

ACUREX: Laboratory selected to analyze soil samples collected during field investigation at Williams Air Force Base.

ADWR: Arizona Department of Water Resources.

AF: Air Force.

AFB: Air Force Base.

ALLUVIUM: Materials eroded, transported and deposited by streams.

ANTICLINE: A fold in which layered strata are inclined down and away from the axes.

AQUICLUDE: Poorly permeable formation that impedes groundwater movement and does not yield to a well or spring.

AQUIFER: A geologic formation, group of formations, or part of a formation that is capable of yielding water to a well or spring.

AQUITARD: A geologic unit which impedes groundwater flow.

AROMATIC: Description of organic chemical compounds in which the carbon atoms are arranged into a ring with special electron stability associated. Aromatic compounds are often more reactive than nonaromatics.

ARTESIAN: Groundwater contained under hydrostatic pressure.

AV: AeroVironment Inc.

AVGAS: Aviation Gasoline.

BES: Bioenvironmental Engineering Services.

BIODEGRADABLE: The characteristic of a substance to be broken down from complex to simple compounds by microorganisms.

BNA: Base/neutral/acid fraction of priority pollutants.

$CaCO_3$: Chemical symbol for calcium carbonate.

CALICHE: Sand, gravel, or desert debris cemented by porous calcium carbonate; formed in semi-arid and arid climates by precipitation of salts at the surface of the ground as the groundwater evaporates.

Cd: Chemical symbol for cadmium.

CIRCA: About; used to indicate an approximate date.

CLAY: A sediment particle having a diameter less than 1/512 mm.

CN^-: Chemical symbol for cyanide.

CONFINED AQUIFER: An aquifer bounded above and below by impermeable strata or by geologic units of distinctly lower permeability than that of the aquifer itself.

CONFINING UNIT: An aquitard or other poorly permeable layer which restricts the movement of groundwater.

CONTAMINATION: The degradation of natural water quality or soil to the extent that its usefulness is impaired; there is no implication of any specific limits since the degree of permissible contamination depends upon the intended end use or uses of the water.

Cr: Chemical symbol for chromium.

Cu: Chemical symbol for copper.

DIP: The angle at which a stratum is inclined from the horizontal.

DISPOSAL FACILITY: A facility or part of a facility at which hazardous waste is intentionally placed into or on land or water, and at which waste will remain after closure.

DISPOSAL OF HAZARDOUS WASTE: The discharge, deposit, injection, dumping, spilling, or placing of any hazardous waste into or on land or water so that such waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including groundwater.

DOD: Department of Defense.

DOWNGRADIENT: In the direction of decreasing hydraulic static head; the direction in which groundwater flows.

DRINKING QUALTY WATER: Water meeting primary drinking water standards.

DUMP: An uncovered land disposal site where solid and/or liquid wastes are deposited with little or no regard for pollution control or aesthetics; dumps are susceptible to open burning and are exposed to the elements, disease vectors and scavengers.

EFFECTIVE PRECIPITATION: The mean annual precipitation minus the mean annual evaporation.

EPA: U.S. Environmental Protection Agency.

EPHEMERAL AQUIFER: A water-bearing zone typically located near the surface which normally contains water seasonally.

E.P. TOXICITY: Extraction procedure toxicity, one criteria for determining if a material is a hazardous waste. The E.P. toxicity test is a leachate simulation established by EPA to determine if toxic material will leach from the waste over time. The test method is specified in 40 CFR 261, Appendix II.

EROSION: The wearing away of land surface by wind, water, or chemical processes.

ES: Engineering-Science, Inc.

EXPLOSIMETER: Monitoring device for detecting explosive gases in ambient air by reading percent of lower explosive limit.

FLOOD PLAIN: The lowland and relatively flat areas adjoining inland and coastal areas of the mainland and off-shore islands, including, at a minimum, areas subject to a one percent or greater chance of flooding in any given year.

FLOW PATH: The direction or movement of groundwater as governed principally by the hydraulic gradient.

FPTA: Fire Protection Training Area.

GC/MS: Gas chromatograph/mass spectrophotometer, a laboratory procedure for identifying unknown organic compounds.

GRAVEL: A collective term for sediments whose particle sizes are greater than 2 mm.

GROUNDWATER: Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure.

GROUNDWATER RESERVOIR: The earth materials and the intervening open spaces that contain groundwater.

HALOGEN: The class of chemical elements including fluorine, chlorine, bromine, and iodine.

HARDFILL: Disposal sites receiving construction debris, wood, miscellaneous spoil material.

HARM: Hazard Assessment Rating Methodology.

HAZARDOUS SUBSTANCE: Under CERCLA, the definition of hazardous substance includes:

1. All substances regulated under Paragraphs 311 and 307 of the Clean Water Act (except oil)

2. All substances regulated under Paragraph 3001 of the Solid Waste Disposal Act

3. All substances regulated under Paragraph 112 of the Clean Air Act

4. All substances which the Administrator of EPA has acted against under Paragraph 7 of the Toxic Substance Control Act

5. Additional substances designated under Paragraph 102 of the Superfund bill

HAZARDOUS WASTE: As defined in RCRA, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

HAZARDOUS WASTE GENERATION: The act or process of producing a hazardous waste.

HEAVY METALS: Metallic elements, including the transition series, which include many elements required for plant and animal nutrition in trace concentrations but which become toxic at higher concentrations.

HYDROCARBONS: Organic chemical compounds composed of hydrogen and carbon atoms chemically bonded. Hydrocarbons may be straight chain, cyclic, branched chain, aromatic, or polycyclic, depending upon arrangement of carbon atoms. Halogenated hydrocarbons are hydrocarbons in which one or more hydrogen atoms has been replaced by a halogen atom.

HYDROPHOBIC REPULSION: The repulsion of oil and oil products by water because of the immiscible properties of oil and water. The oil or oil products will remain above the water layer.

I.D.: Inside diameter.

INFILTRATION: The movement of water through the soil surface into the ground.

IRP: Installation Restoration Program.

JP-4: Jet Propulsion Fuel Number Four, military jet fuel.

LEACHATE: A solution resulting from the separation or dissolving of soluble or particulate constituents from solid waste or other man-placed medium by percolation of water.

LEACHING: The process by which soluble materials in the soil, such as nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

LINER: A continuous layer of natural or man-made materials beneath or on the sides of a surface impoundment, landfill, or landfill cell which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents or leachate.

LITHOLOGY: The description of the physical character of a rock.

MEK: Methyl Ethyl Ketone.

METALS: See "Heavy Metals."

MOGAS: Motor gasoline.

MONITORING WELL: A well used to measure groundwater levels and to obtain samples.

MSL: Mean Sea Level.

NOAA: National Oceanic and Atmospheric Administration.

NONINTRUSIVE: Method of investigation in which information may be gained without disturbing the object being investigated.

OD: Outside diameter.

O_2: Oxygen molecule.

OEHL: Occupational and Environmental Health Laboratory.

O&G: Symbols for oil and grease.

ORGANIC: Being, containing or relating to carbon compounds, especially in which hydrogen is attached to carbon.

OVM: Organic vapor meter.

Pb: Chemical symbol for lead.

PCB: Polychlorinated Biphenyl; liquids used as a dielectrics in electrical equipment.

PELLICULAR: A term applied to water (or any liquid) adhering as films to the surfaces of openings and occurring as wedge-shaped bodies at junctures of interstices in the unsaturated zone above the capillary fringe.

PERCHED WATER TABLE: A water table above a relatively impermeable zone underlain by unsaturated rocks of sufficient permeability to allow groundwater movement.

PERCOLATION: Movement of moisture by gravity or hydrostatic pressure through interstices of unsaturated rock or soil.

PERMEABILITY: The capacity of a porous rock, soil or sediment for transmitting a fluid without damage to the structure of the medium.

PERSISTENCE: As applied to chemicals, those which are very stable and remain in the environment in their original form for an extended period of time.

PESTICIDE: An agent used to destroy pests. Pesticides include such specialty groups as herbicides, fungicides, insecticides, etc.

PHENOL: Total recoverable phenolics -- any of various acidic compounds analogous to phenol and regarded as hydroxyl derivatives of aromatic hydrocarbons.

POLLUTANT: Any introduced gas, liquid or solid that makes a resource unfit for a specific purpose.

POTENTIOMETRIC SURFACE: The imaginery surface to which water is an artesian aquifer would rise in tightly screened wells penetrating it.

PPB: Parts per billion by weight, equivalent to μg/kg.

PPM: Parts per million by weight, equivalent to μg/g.

PRECIPITATION: Rainfall.

QA/QC: Quality assurance/quality control.

RCRA: Resource Conservation and Recovery Act.

RECEPTORS: The potential impact group or resource for a waste contamination source.

RECHARGE: The addition of water to the groundwater system by natural or artificial processes.

RECHARGE AREA: A surface area in which surface water or precipitation percolates through the unsaturated zone and eventually reaches the zone of saturation. Recharge areas may be natural or man-made.

REMANENT MAGNETISM: That component of a rock's magnetism whose direction is fixed relative to the rock and is independent of moderate, applied magnetic fields.

SAND: Particles of sediment having diameters larger than 1/16 mm (62 microns) and smaller than 2 mm.

SANITARY LANDFILL: A land disposal site using an engineered method of disposing solid wastes on land in a way that minimizes environmental hazards.

SATURATED ZONE: That part of the earth's crust in which all voids are filled with water.

SCS: U.S. Department of Agriculture Soil Conservation Service.

SILT: Sediment particles having diameters larger than 1/512 mm (2 microns) and smaller than 1/16 mm (62 microns).

SLUDGE: The solid residue resulting from a manufacturing or wastewater treatment process which also produces a liquid stream.

SOLID WASTE: Any garbage, refuse, or sludge from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid semisolid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923).

SPECIFIC RETENTION: The ratio of (1) the volume of a liquid which, after being saturated, it will retain against the pull of gravity to (2) its own volume. It is stated as a percentage.

SPIKE: A quality control check consisting of a chemical or solution of a known concentration presented to the lab for analysis as an unknown.

SPILL: Any unplanned release or discharge of a hazardous waste onto or into the air, land, or water.

STORAGE OF HAZARDOUS WASTE: Containment, either on a temporary basis or for a longer period, in such a manner as not to constitute disposal of such hazardous waste.

SYNCLINE: A fold in rocks in which the strata dip inward from both sides toward the axis.

TOXICITY: The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism.

TREATMENT OF HAZARDOUS WASTE: Any method, technique, or process including neutralization designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize the waste or so as to render the waste nonhazardous.

U OF A: University of Arizona.

UNSATURATED ZONE: Zone above the water table. Most of the time the pore space between soil particles in this zone is filled with air, except near grain-to-grain boundaries where surface tention maintains a film of water between the particles.

UPGRADIENT: In the direction of increasing hydraulic static head; the direction opposite to the prevailing flow of groundwater.

USAF: United States Air Force.

USGS: United States Geological Survey.

VOA: Volatile organic analysis, fraction of priority pollutants.

WAFB: Williams Air Force Base.

WATER TABLE: Surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere.

WWTP: Wastewater Treatment Plant.

APPENDIX B

Scope of Work

7 NOV 1984

INSTALLATION RESTORATION PROGRAM
PHASE II-CONFIRMATION/QUANTIFICATION (STAGE 1)
WILLIAMS AFB ARIZONA *

I. DESCRIPTION OF WORK

The purpose of this task is to undertake a field investigation at Williams AFB Arizona (1) to determine the presence or absence of contamination within the specified areas of investigation; (2) if contamination exists, determine the potential for migration of those contaminants in the various environmental media; (3) identify additional investigations necessary to determine the magnitude, extent, direction and rate of migration of discovered contaminants; and (4) identify potential environmental consequences and health risks of migrating pollutants.

The Phase I IRP Report (mailed under separate cover) incorporates the background and description of the sites for this task. To accomplish this survey effort, the contractor shall take the following actions:

A. General

1. The contractor shall monitor all exploratory borehole operations with a photo-ionization meter or equivalent organic vapor detection device to identify potential generation of hazardous and/or toxic materials. In addition, the contractor shall monitor drill cuttings for discoloration and odor. During drilling operations, if soil cuttings are suspected to be hazardous, the contractor will place them in proper containers and test them for EP Toxicity and Ignitibility. Results of monitoring shall be included in boring logs. A maximum of six samples shall be collected for EP Toxicity and Ignitibility testing.

2. All chemical analyses shall meet the required limits of detection for the applicable EPA method identified in Attachment 1.

3. Locations where surface sediment samples are taken, or where soil exploratory borings are drilled shall be marked with a permanent marker, and the location marked on a project map of the site.

4. Upon completion of each boring, the borehole will be grouted from the bottom of the hole to the land surface in order to prevent cross-aquifer contamination.

5. Either disposable scoops or stainless steel split spoon samplers (alternate sampling devices may be used near the fuel storage tanks) will be used on all soil exploratory borings.

6. Field data collected for each site shall be plotted and mapped. The nature, magnitude, and potential for contaminant flow within each zone to receiving streams and groundwaters shall be estimated. Upon completion of the sampling and analysis, the data shall be tabulated in the next R&D Status report as specified in Item VI below.

F33615-83-D-4000/0005

*Modifications are underlined

7. Determine the areal extent of the sites by receiving available aerial photos of the base, both historical and the most recent panchromatic and infrared.

8. Split all soil samples as part of the contractor's specific Quality Assurance/Quality Control (QA/QC) protocols and procedures. One set of samples shall be analyzed by the contractor and the other set of samples shall be forwarded for analysis through overnight delivery to:

USAF OEHL/SA
Bldg 140
Brooks AFB TX 78235

The samples sent to the USAF OEHL/SA shall be accompanied by the following information:

(a) Purpose of sample (analyte)

(b) Installation name (base)

(c) Sample number (on containers)

(d) Source/location of sample

(e) Contract Task Numbers and Title of Project

(f) Method of collection (bailer, section pumps, air-lift pump, etc.)

(g) Volumes removed before sample taken

(h) Special conditions (use of surrogate standard, special nonstandard preservations, etc.)

(i) Preservatives used

This information shall be forwarded with each sample by properly completing an AF Form 2752 (copy of form and instruction on proper completion mailed under separate cover). In addition, copies of field logs documenting sample collection should accompany the samples.

Chain-of-custody records for all samples, field blanks, and quality control duplicates shall be maintained.

9. An additional 10% of all samples, for each parameter, shall be analyzed for quality control purposes, as indicated in Attachment 1.

B. In addition to the general items delineated in A above, conduct the following specific actions at sites identified on Williams AFB:

1. Fire Protection Training Area No. 2

a. Obtain 2 soil borings in the drainage channel south of the separator pit. Collect a soil sample at the surface and at depth of 4 feet,

for a total of 4 samples and a total boring depth of 8 feet. Analyze the samples for total organic halogens, oil and grease, phenols and lead.

b. Obtain a total of 13 soil borings (including one control) around and between the two fire pits and adjacent to the drum storage area, each to a depth of 25 feet. Samples will be collected at the following depths and at any major soil interface, not to exceed 11 samples per boring: 0.5, 1.5, 3.5, 5.5, 7.5, and 10.0 feet. Total number of samples shall not exceed 96, and total boring depth shall not exceed 170 feet. Analyses will be performed on the shallow samples first before deciding on the need to analyze the deeper samples. Analyze the samples for total organic halogens, oil and grease, phenols, and lead.

2. Liquid Fuels Storage Area

a. Obtain 1 soil boring in the leak area (facility 548), to a depth of 45 feet. Collect soil samples at 3-foot intervals, for a total of 14 samples. Analyze the samples for total organic halogens, oil and grease, phenols, and lead.

b. Obtain 6 soil borings at the three spill areas (facilities 538 and 555), plus 1 control boring, for a total of 7 borings. Perform 2 borings at each area; each to a depth of 10 feet. Samples will be collected at the following depths and at any major soil interface, not to exceed 8 samples per boring: 0.5, 1.5, 3.5, 5.5, 7.5, and 10.0 feet. Total number of samples shall not exceed 56, and a total boring depth of 70 feet. Analyze the samples for total organic halogens, oil and grease, phenols, and lead.

3. Surface Drainage System-Southwest

Obtain 6 soil borings in the southwest drainage system at 4 locations in the open drainage channel, 1 in the retention pond, plus 1 control. Collect a soil sample at the surface and at a depth of 4 feet, for a total of 12 samples and a total boring depth of 24 feet. Analyze the samples for total organic halogens, oil and grease, phenols, lead, methyl ethyl ketone, cyanide, copper, chromium, and cadmium.

4. Landfill

Obtain 6 slanted soil borings spaced at regular intervals around the perimeter of the site, plus one vertical control boring. Total boring depth at the landfill shall not exceed 700 feet. Collect soil samples at 4-foot intervals beside/under the landfill, for a total of 175 samples. Analyze the samples for total organic halogens, oil and grease, phenols, lead, chromium, and cadmium.

5. Pesticide Burial Site

a. Perform a survey by magnetometer and an electromagnetic resistivity device to identify the specific area where drums and/or containers are buried.

b. Place a concrete marker at appropriate locations in the ground to allow for relocation of the drum(s) in the future.

6. Surface Drainage System-Northwest

Obtain 4 soil borings in the northwest drainage system at 3 locations in the open drainage channel, plus 1 control. Collect a soil sample at the surface and at a depth of 4 feet, for a total of 8 samples and a total boring depth of 16 feet. Analyze the samples for total organic halogens, oil and grease, phenols, leads, and methyl ethyl ketone.

C. Borehole Cleanup

All boring area cuttings shall be removed and the general area cleaned following the completion of each boring. Only those drill cuttings suspected as being a hazardous waste (based on discoloration, odor, or organic vapor detection instrument) shall be properly containerized (according to local civil engineering office requirements) by the contractor for eventual government disposal. The suspected hazardous waste shall be tested by the contractor for EP toxicity and Ignitibility. The contractor is not responsible for ultimate disposal of the drill cuttings. Disposal will be conducted by base personnel.

D. Data Review

Results of sampling and analysis shall be tabulated and incorporated in the Informal Technical Information Report (as specified in Item VI below) and forwarded to the USAF OEHL for review. Results shall also be forwarded as available in the next monthly R&D status report.

E. Reporting

1. A draft report delineating all findings of this field investigation shall be prepared and forwarded to the USAF OEHL (as specified in Item VI below) for Air Force review and comment. This report shall include a discussion of the regional/site specific hydrogeology, well and boring logs, data from water level surveys, groundwater surface and gradient maps, water quality and soil analysis results, available geohydrologic cross sections, and laboratory quality assurance information. The report shall follow the USAF OEHL supplied format (mailed under separate cover).

2. The recommendation section will address each site and list them by categories. Category I will consist of sites where no further action (including remedial action) is required. Data for these sites is considered sufficient to rule out unacceptable health or environmental risks. Category II sites are these requiring additional monitoring or work to quantify or further assess the extent of current or future contamination. Category III sites are sites that will require remedial actions (ready for IRP Phase IV actions). In each case, the contractor wil summarize or present the results of field data, environmental or regulatory criteria, or other pertinent information supporting these conclusions.

F. Meetings

The contractor's project leader shall attend one meeting with Air Force headquarters and regulatory personnel to take place at a time to be specified by the USAF OEHL. The meeting shall take place at Williams AFB for a duration of one day (eight hours).

II. SITE LOCATION AND DATES:

Williams AFB AZ
Date to be established

III. BASE SUPPORT: None

IV. GOVERNMENT FURNISHED PROPERTY: None

V. GOVERNMENT POINTS OF CONTACT:

1. Maj Dennis D. Brownley
USAF OEHL/TSS
Brooks AFB TX 78235
(512) 536-2158
AV 240-2158

2. Capt Ruel F. Burns
USAF Hosp Williams/SGPB
Williams AFB AZ 85224
(602) 988-2611, ext 6516
AV 474-6516

3. Lt Col Ronald L. Schiller
HQ ATC/SGPB
Randolph AFB TX 78150
(512) 652-5271
AV 487-5271

VI. In addition to sequence numbers 1*, 5 and 10 in Attachment 1 to the contract which are applicable to all orders, the sequence numbers listed below are applicable to this order. Also shown are data applicable to this order.

Sequence No.	Block 10	Block 11	Block 12	Block 13	Block 14
3	O/Time	**	**		
4	One/R	10 Dec 84	24 Dec 84	1 May 85	***

*Forward a copy of the R&D Status Report to all government POC's identified in Section V.

**Upon completion of analytical effort before submission of 1st draft report.

***Two draft reports will be required. After incorporating Air Force comments concerning the first draft report, the contractor shall supply the USAF OEHL with one copy of the second draft report. Upon acceptance of the second draft, the USAF OEHL will furnish a distribution list for the remaining 24 copies of the second draft. The contractor shall supply 50 copies plus the original camera ready copy of the final report.

Attachment 1
Analytical Methods, Detection Limits, and Number of Samples

ANALYTE	METHOD	DETECTION LIMIT (ug/g) soil	No. of Samples	QA	Total Samples
Total Organic Halogen (TOX)	EPA 9020	5	365	37	402
Oil and Grease (using IR)	EPA 413.2	100	365	37	402
Phenol	EPA 420.1	1	365	37	402
Methyl Ethyl Ketone (MEK)	EPA 503.1	.001	20	2	22
Cyanide	Standard 412	2	12	2	14
METALS:					
Cadmium	EPA 213.2	0.2	187	19	206
Chromium	EPA 218.1	5	187	19	206
Copper	EPA 220.1	0.4	12	2	14
Lead	EPA 239.2	2	361	37	402
EP Toxicity	40 CFR 261.2	*	5	1	6
Ignitibility	40 CFR 261.21	**	5	1	6

* Metal	ug/L of solution
As	10
Ba	200
Cd	10
Cr	50
Pb	20
Hg	1
Se	10
Ag	10

** Find if sample is ignitable at 140 degrees F. or below. If so, it is a hazardous waste.

4. Performance of this order shall not proceed until the Contractor receives a formal delivery order or verbal instructions from the Contracting Officer.

5. If the Contractor concurs with the order conditions specified, he shall so indicate by signing and forwarding two copies of this letter to USAF OEHL/TS, Brooks AFB TX 78235. If he does not agree with any of the conditions, he shall call USAF OEHL/TS to discuss proposed changes.

EMILE BALADI
Chief, Technical Services Division

1 Atch
Task Description

cc: ASD/PMRSC

APPROVED

CHRISTOPHER D. MILLER
Contracting Officer

The Contractor hereby concurs in the Order conditions set forth above and will perform accordingly.

Signature: ______________________

Title: Vice President

Date: 11/20/84

APPENDIX C

Sample Numbering System

C. SAMPLE NUMBERING SYSTEM

All soil samples collected at Williams AFB were given a six digit code for rapid identification. The first two digits of the code indicate the site from which the sample was taken. The following codes were used for the five sampled sites:

FP - Fire Protection Training Area
LI - Liquid Fuels Storage Area
LA - Landfill
SW - Southwest Drainage Channel
NW - Northwest Drainage Channel
WA - Drums of Drill Cuttings

The second two digits indicate the sample location within a site. These numbers were assigned in chronological order, so the first number is the first sample location at that site. Sampling locations are shown in Figure I-2. For example, LA-01 is the *first location sampled at the landfill*. The exceptions to the sequential location numbering are the background borings. The background sampling location was always assigned the highest planned location number for that site. For example, on samples SW-01, 02, ... 06, SW-06 is the background sample. One sample location (boring) was added while in the field at the FPTA. As a result, FP-15 is a regular sampling location and FP-14 is the background (14 borings were planned). One of the nine planned borings at the LFSA was dropped while in the field, so LI-09 is the background, but there is no LI-08.

The last two digits of the sample code indicate the sample taken from each location. The code numbers increase with depth, but do not reflect the actual depth where the sample was taken.

The sample code is used to identify the sample and reflect the relative location from which it was collected. For example, sample FP-07-05 is the fifth sample collected at boring seven at the FPTA and SW-04-01 is the surface sample from the fourth hand boring four in the southwest drainage.

Quality assurance samples were given "QA" as the second two digits of the sample code. QA samples were identified only by sampling location, and the fact that they were a quality assurance duplicate sample. QA samples were numbered sequentially within each site. For example LA-QA-02 is the second QA sample taken at the landfill. The location of the QA sample was recorded in the logbook and not on the sample paperwork. The laboratory did not know which sample matched the QA sample.

The sample code is used exclusively to identify samples in this report. Tables IV-1 through IV-40 also show the laboratory number given to the samples which were analyzed. Table C-1 coorelates AV's sample code to the USAF sample numbers logged on samples sent to the OEHL laboratory.

TABLE C-1. Sample number comparison.

AV Sample Code	USAF Sample Code	AV Sample Code	USAF Sample Code
FP-08-02	GS-84-0210	FP-06-03	GS-84-0255
FP-09-04	GS-84-0211	FP-06-02	GS-84-0256
FP-07-05	GS-84-0212	FP-05-01	GS-84-0257
FP-09-06	GS-84-0213	FP-05-02	GS-84-0258
FP-08-03	GS-84-0214	FP-03-04	GS-84-0259
FP-09-03	GS-84-0215	FP-05-03	GS-84-0260
FP-07-03	GS-84-0216	FP-03-01	GS-84-0261
FP-03-03	GS-84-0217	FP-15-07	GS-84-0262
FP-14-03	GS-84-0218	FP-10-07	GS-84-0263
FP-09-09	GS-84-0219	FP-15-01	GS-84-0264
FP-14-05	GS-84-0220	FP-15-04	GS-84-0265
FP-03-02	GS-84-0221	FP-10-06	GS-84-0266
FP-07-02	GS-84-0222	FP-15-03	GS-84-0267
FP-04-01	GS-84-0223	FP-15-02	GS-84-0268
FP-09-08	GS-84-0224	FP-15-08	GS-84-0269
FP-04-04	GS-84-0225	FP-13-01	GS-84-0270
FP-04-02	GS-84-0226	FP-13-02	GS-84-0271
FP-09-01	GS-84-0227	FP-10-02	GS-84-0272
FP-07-04	GS-84-0228	FP-13-03	GS-84-0273
FP-04-06	GS-84-0229	FP-10-03	GS-84-0274
FP-03-06	GS-84-0230	FP-13-06	GS-84-0275
FP-14-04	GS-84-0231	FP-13-05	GS-84-0276
FP-04-08	GS-84-0232	FP-11-02	GS-84-0277
FP-04-07	GS-84-0233	FP-13-04	GS-84-0278
FP-08-01	GS-84-0234	FP-11-01	GS-84-0279
FP-08-05	GS-84-0235	FP-11-04	GS-84-0280
FP-04-03	GS-84-0236	FP-11-05	GS-84-0281
FP-08-06	GS-84-0237	FP-10-05	GS-84-0282
FP-09-02	GS-84-0238	FP-09-11	GS-84-0283
FP-08-04	GS-84-0239	FP-10-01	GS-84-0284
FP-09-10	GS-84-0240	FP-11-03	GS-84-0285
FP-09-05	GS-84-0241	FP-15-05	GS-84-0286
FP-14-01	GS-84-0242	FP-15-06	GS-84-0287
FP-14-02	GS-84-0243	FP-10-04	GS-84-0288
FP-04-05	GS-84-0244	FP-12-04	GS-84-0289
FP-07-01	GS-84-0245	FP-12-02	GS-84-0290
FP-06-06	GS-84-0246	FP-12-03	GS-84-0291
FP-08-08	GS-84-0247	FP-12-05	GS-84-0292
FP-06-05	GS-84-0248	FP-12-01	GS-84-0293
FP-06-04	GS-84-0249	LI-09-01	GS-84-0294
FP-06-07	GS-84-0250	LI-09-02	GS-84-0295
FP-03-05	GS-84-0251	LI-09-03	GS-84-0296
FP-05-04	GS-84-0252	LI-09-04	GS-84-0297
FP-08-07	GS-84-0253	LI-09-05	GS-84-0298
FP-06-01	GS-84-0254	LI-10-01	GS-84-0299

TABLE C-1. (Continued)

AV Sample Code	USAF Sample Code	AV Sample Code	USAF Sample Code
LI-01-02	GS-84-0300	LI-03-01	GS-84-0345
LI-01-03	GS-84-0301	LI-03-02	GS-84-0346
LI-01-04	GS-84-0302	LI-03-03	GS-84-0347
LI-01-05	GS-84-0303	LI-03-04	GS-84-0348
LI-01-06	GS-84-0304	LI-03-05	GS-84-0349
LI-02-01	GS-84-0305	LI-03-06	GS-84-0350
LI-02-02	GS-84-0306	LI-03-07	GS-84-0351
LI-02-03	GS-84-0307	LI-03-08	GS-84-0352
LI-02-04	GS-84-0308	LI-03-09	GS-84-0353
LI-02-05	GS-84-0309	LI-03-11	GS-84-0354
LA-07-02	GS-84-0310	LI-03-12	GS-84-0355
LA-07-11	GS-84-0311	LA-01-01	GS-84-0356
LA-07-08	GS-84-0312	LA-01-02	GS-84-0357
LA-07-15	GS-84-0313	LA-01-03	GS-84-0358
LA-07-13	GS-84-0314	LA-01-04	GS-84-0359
LA-07-16	GS-84-0315	LA-01-05	GS-84-0360
LA-07-09	GS-84-0316	LA-01-06	GS-84-0361
LA-07-05	GS-84-0317	LA-01-07	GS-84-0362
LA-07-17	GS-84-0318	LA-01-08	GS-84-0363
LA-07-04	GS-84-0319	LA-01-10	GS-84-0364
LA-07-03	GS-84-0320	LA-01-11	GS-84-0365
LA-07-07	GS-84-0321	LA-01-12	GS-84-0366
LA-07-06	GS-84-0322	LA-01-13	GS-84-0367
LA-07-10	GS-84-0323	LA-01-14	GS-84-0368
LA-07-12	GS-84-0324	LA-01-15	GS-84-0369
LA-07-14	GS-84-0325	LA-02-01	GS-84-0370
LA-07-01	GS-84-0326	LA-02-02	GS-84-0371
LI-04-01	GS-84-0327	LA-02-03	GS-84-0372
LI-04-02	GS-84-0328	LA-02-04	GS-84-0373
LI-04-03	GS-84-0329	LA-02-05	GS-84-0374
LI-04-04	GS-84-0330	LA-02-06	GS-84-0375
LI-04-05	GS-84-0331	LA-02-07	GS-84-0376
LI-05-01	GS-84-0332	LA-02-08	GS-84-0377
LI-05-02	GS-84-0333	LA-02-09	GS-84-0378
LI-05-03	GS-84-0334	LA-02-10	GS-84-0379
LI-05-04	GS-84-0335	LA-02-11	GS-84-0380
LI-05-05	GS-84-0336	LA-03-01	GS-84-0381
LI-06-01	GS-84-0337	LA-03-02	GS-84-0382
LI-06-02	GS-84-0338	LA-03-03	GS-84-0383
LI-06-03	GS-84-0339	LA-03-04	GS-84-0384
LI-07-01	GS-84-0340	LA-03-05	GS-84-0385
LI-07-02	GS-84-0341	LA-03-06	GS-84-0386
LI-07-03	GS-84-0342	LA-03-07	GS-84-0387
LI-07-04	GS-84-0343	LA-03-08	GS-84-0388
LI-07-05	GS-84-0344	LA-03-09	GS-84-0389

TABLE C-1. (Continued)

AV Sample Code	USAF Sample Code	AV Sample Code	USAF Sample Code
LA-03-10	GS-84-0390	LA-06-04	GS-84-0424
LA-03-12	GS-84-0391	LA-06-05	GS-84-0425
LA-03-13	GS-84-0392	LA-06-06	GS-84-0426
LA-03-14	GS-84-0393	LA-06-07	GS-84-0427
LA-04-01	GS-84-0394	LA-06-08	GS-84-0428
LA-04-02	GS-84-0395	LA-06-09	GS-84-0429
LA-04-03	GS-84-0396	LA-06-10	GS-84-0430
LA-04-04	GS-84-0397	LA-06-11	GS-84-0431
LA-04-05	GS-84-0398	LA-06-12	GS-84-0432
LA-04-06	GS-84-0399	SW-01-01	GS-84-0433
LA-04-07	GS-84-0400	SW-01-02	GS-84-0434
LA-04-08	GS-84-0401	SW-02-01	GS-84-0435
LA-04-09	GS-84-0402	SW-02-02	GS-84-0436
LA-04-10	GS-84-0403	SW-03-01	GS-84-0437
LA-04-11	GS-84-0404	SW-03-02	GS-84-0438
LA-04-12	GS-84-0405	SW-04-01	GS-84-0439
LA-04-13	GS-84-0406	SW-04-02	GS-84-0440
LA-04-14	GS-84-0407	SW-05-01	GS-84-0441
LA-04-15	GS-84-0408	SW-05-02	GS-84-0442
LA-04-16	GS-84-0409	SW-06-01	GS-84-0443
LA-05-01	GS-84-0410	SW-06-02	GS-84-0444
LA-05-02	GS-84-0411	FP-01-01	GS-84-0445
LA-05-03	GS-84-0412	FP-01-02	GS-84-0446
LA-05-04	GS-84-0413	FP-02-01	GS-84-0447
LA-05-05	GS-84-0414	FP-02-02	GS-84-0448
LA-05-06	GS-84-0415	NW-01-01	GS-84-0449
LA-05-07	GS-84-0416	NW-02-01	GS-84-0450
LA-05-08	GS-84-0417	NW-03-01	GS-84-0451
LA-05-09	GS-84-0418	NW-04-01	GS-84-0452
LA-05-10	GS-84-0419	NW-04-02	GS-84-0453
LA-05-11	GS-84-0420	WA-01	GS-84-0454
LA-06-01	GS-84-0421	WA-02	GS-84-0455
LA-06-02	GS-84-0422	WA-03	GS-84-0456
LA-06-03	GS-84-0423	WA-04	GS-84-0457

APPENDIX D

Boring Logs

GEOTECHNICAL BORING LOG

BORING NO. FP-03

Project Name Williams I.R.P.
Logged By TO'G
Project No. 10416E
No. of Samples 6
Checked By
Site F.P.T.A.
Drilling Method Auger
Date 9-24-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Clayey sand			OVM Readings: 5.5 @ 4' 27 @ 10'
5		Sandy clay - red, moist			170 with auger out of hole
		Clayey sand			
10					10.0 ft total depth

AV-F-HW02

GEOTECHNICAL BORING LOG

BORING NO. FP-04

Project Name Williams I.R.P. Logged By TO'G

Project No. 10416E No. of Samples 9 Checked By

Site FPTA Drilling Method Auger Date 9-24-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Clayey sand - red			OVM Readings: None over background during drilling
5					190 ppm with augers withdrawn to 4.5'
					120 - open hole to 14.5'
10		Sandy clay - red			
15					14.5 ft total depth

AV-F-HW02

GEOTECHNICAL BORING LOG

BORING NO. FP-05

Project Name Williams I.R.P. Logged By TO'G
Project No. 10416E No. of Samples 4 Checked By
Site FPTA Drilling Method Auger Date 9-25-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Clayey sand			OVM Readings: 26 ppm - open hole
5		Fine to very fine sand and silt			
		As above with light cement			
10		Fine to very fine sand and silt			10.0 ft total depth

AV-F-HW02

GEOTECHNICAL BORING LOG

BORING NO. FP-06

Project Name Williams I.R.P. Logged By TO'G

Project No. 10416E No. of Samples 9 Checked By

Site FPTA Drilling Method Auger Date 9-25-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Silty sand			OVM Readings: 25 - open hole 8 - background
5		Clayey sand and silt			
10		Cemented sand inter-bedded with silty and clayey fine sand			
15		Fine pebble gravel and sand			14.5 ft total depth

AV-F-H'V02

GEOTECHNICAL BORING LOG

BORING NO. FP-07

Project Name: Williams I.R.P. Logged By: TO'G

Project No.: 10416E No. of Samples: 5 Checked By:

Site: FPTA Drilling Method: Auger Date: 9-25-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Silty fine sand			OVM Readings:
					25 ppm - open hole
5		Clayey fine sand			8 ppm - background
		Cemented as above			
10		Silty fine sand			
					10.0 ft total depth

AV-F-HW02

GEOTECHNICAL BORING LOG

BORING NO. FP-08

Project Name Williams I.R.P. | Logged By TO'G

Project No. 10416E | No. of Samples 9 | Checked By

Site FPTA | Drilling Method Auger | Date 9-25-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
5		Silty very fine sand			OVM Readings: 84 - just below surface 80 - open hole @ 5'
		As above with fine pebble gravel			430 above background in 10' core
10		Lightly cemented very fine sand and silt			Can't smell anything on lower level samples - 360 when auger exposed top layers during withdrawal
15					14.5 ft total depth

GEOTECHNICAL BORING LOG

BORING NO. FP-09

Project Name: Williams I.R.P.		Logged By: TO'G	
Project No.: 10416E	No. of Samples: 11	Checked By:	
Site: FPTA	Drilling Method: Auger	Date: 9-27-84	

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
5		Silty clay - moist with fuel			OVM Readings: 58 - background 1030 ppm - 5 ft - hole 200-400 - core @ 5' 85 - core @ 10.5'
10		Fine to very fine sand with silt			
15		Fine sand with fine pebble gravel			
20		Silty fine sand			
25					24.5 ft total depth

GEOTECHNICAL BORING LOG

BORING NO. FP-10

Project Name Williams I.R.P. Logged By TO'G

Project No. 10416E No. of Samples 7 Checked By

Site FPTA Drilling Method Auger Date 9-27-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Medium sand and well rounded medium pebble gravel (fill mat'l around drain)			No significant OVM readings in hole
5					
		Fine to medium sand			
		Fine sand and gravel			
10		Lightly cemented sand			10.0 ft total depth

GEOTECHNICAL BORING LOG

BORING NO. FP-11

Project Name Williams I.R.P. Logged By TO'G

Project No. 10416E No. of Samples 6 Checked By

Site FPTA Drilling Method Auger Date 9-27-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Fine to medium sand			No significant OVM readings
		Clayey silt			
5					
		Sandy silt			
10		Fine to very fine sand and silt slightly cemented			10.0 ft total depth

AV-F-HV02

GEOTECHNICAL BORING LOG

BORING NO. FP-12

Project Name	Williams I.R.P.	Logged By	TO'G
Project No. 10416E	No. of Samples 5	Checked By	
Site FPTA	Drilling Method Auger	Date	9-27-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Silty clay and very fine sand			No significant OVM readings
5		Fine to very fine sand			
10		As above with light cement			10.5 ft total depth

AV-F-HV02

GEOTECHNICAL BORING LOG

BORING NO. FP-13

Project Name	Williams I.R.P.			Logged By	TO'G
Project No.	10416E	No. of Samples	6	Checked By	
Site	FPTA	Drilling Method	Auger	Date	9-27-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Top 4" moist - with odor			No significant OVM readings
5		Silty fine to medium sand			
10		As above with light cement			10.0 ft total depth

AV-F-HW02

GEOTECHNICAL BORING LOG

BORING NO. FP-14

Project Name Williams I.R.P. Logged By TO'G

Project No. 10416E No. of Samples 5 Checked By

Site FPTA Drilling Method Auger Date 9-24-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Clayey sand - red			No significant OVM readings
5					
		Cemented sand			
10		Clayey sand - red			10.0 ft total depth

AV-F-HW02

GEOTECHNICAL BORING LOG

BORING NO. FP-15

Project Name: Williams I.R.P. | Logged By: TO'G

Project No.: 10416E | No. of Samples: 9 | Checked By:

Site: FPTA | Drilling Method: Auger | Date: 9-27-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft (10 30 50)	Remarks
		Silty sand			OVM Readings: 140 ppm - 5 ft; 380 max. for hole
5		Fine sand with silt			
10		Silty sand			
15		Well cemented silt			14.5 ft total depth

AV-F-HW02

GEOTECHNICAL BORING LOG

BORING NO. LI-01

Project Name Williams I.R.P. Logged By TO'G

Project No. 10416E No. of Samples 6 Checked By

Site LFSA Drilling Method Auger Date 9-28-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Clayey, very fine sand and silt			No significant OVM readings in hole
5		Fine to medium sand			
		Silty sand - light cement			
10		Fine to medium sand			10.0 ft total depth

GEOTECHNICAL BORING LOG

BORING NO. LI-02

Project Name Williams I.R.P. Logged By TO'G

Project No. 10416E No. of Samples 6 Checked By

Site LFSA Drilling Method Auger Date 9-28-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
5		Fine to very fine sand and silt			No significant OVM readings in hole
		Medium to coarse sand			
		As above, but cemented			
10		Fine sand and silt			10.0 ft total depth

GEOTECHNICAL BORING LOG

BORING NO. LI-03

Project Name Williams I.R.P. Logged By TO'G

Project No. 10416E No. of Samples 13 Checked By

Site LFSA Drilling Method Auger Date 10-2-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Fine to medium sand			OVM Readings:
					Background - 13 ppm
5		Silty sand			23 @ 10'
					28 @ 15'
		As above with light cement			60 @ 18' in core
					580 in shoe @ 29.5'
		Fine to medium sand			180 in shoe @ 35'
10		Silty fine sand			540 in shoe @ 40'
		As above with light cement			710 @ 45'
15		Fine to medium sand			
		Fine to medium silty sand			
20		Fine to medium sand			
25					
30		Fine to medium sand and silt			
35					
40		Fine to medium sand & medium pebble gravel			
		Medium to coarse sand and fine to medium pebble gravel			
45					45.0 ft total depth

GEOTECHNICAL BORING LOG

BORING NO. LI-04

Project Name	Williams I.R.P.	Logged By	TO'G
Project No.	10416E	No. of Samples	6
Checked By			
Site	LFSA	Drilling Method	Auger
Date	10-2-84		

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Clay with fine sand			No significant OVM readings
5		Silty clay			
		Medium to coarse sand			
		Fine to medium sand			
10		Heavy cement			
		Very fine sand with silt			10.0 ft total depth

AV-F-HV02

GEOTECHNICAL BORING LOG

BORING NO. LI-05

Project Name	Williams I.R.P.			Logged By	TO'G
Project No.	10416E	No. of Samples	5	Checked By	
Site	LFSA	Drilling Method	Auger	Date	10-2-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Clay with silt			No significant OVM readings
5		Medium to fine sand with clay			
		Fine to very fine sand with silt			
10		Fine to medium sand			10.0 ft total depth

AV-F-HV02

GEOTECHNICAL BORING LOG

BORING NO. LI-06

Project Name Williams I.R.P. Logged By TO'G

Project No. 10416E No. of Samples 4 Checked By

Site LFSA Drilling Method Auger Date 10-2-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Medium pebble gravel w/ fine to medium sand			No significant OVM readings
5		Clay with silt			
		Fine to medium sand			
		As above with gravel			
10		Fine to medium sand and silt, lightly cemented			9.5 ft total depth

AV-F-HV02

GEOTECHNICAL BORING LOG

BORING NO. LI-07

Project Name Williams I.R.P.
Logged By TO'G
Project No. 10416E
No. of Samples 5
Checked By
Site LFSA
Drilling Method Auger
Date 10-2-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Gravel			OVM Readings:
		Silty clay			120 @ 5 ft
		Fine to medium sand with silt			160 @ 10 ft in shoe
5					20-30 @ 10 ft in barrel
		Fine to medium sand			
		Fine to medium sand with gravel			
10		Silty fine sand			10.0 ft total depth

GEOTECHNICAL BORING LOG

BORING NO. LI-09

Project Name Williams I.R.P. Logged By TO'G

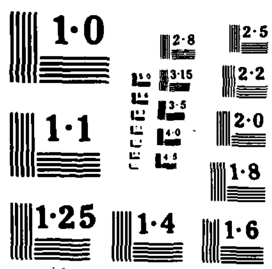
Project No. 10416E No. of Samples 6 Checked By

Site LFSA Drilling Method Auger Date 9-28-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Silty fine to medium sand			No significant OVM readings
5		As above with light cement			
		As above w/heavy cement			
10		Fine to very fine sand and silt			10.0 ft total depth

AV-F-HV02

AD-A167 798 INSTALLATION RESTORATION PROGRAM PHASE II 3/4
CONFIRMATION/QUANTIFICATION STA..(U) AEROVIRONMENT INC
MONROVIA CA 24 JAN 86 F33615-83-D-4000 TR-85-86
UNCLASSIFIED F/G 13/2 NL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1·6

GEOTECHNICAL BORING LOG

BORING NO. LA-01

Project Name: Williams I.R.P. — Logged By: TO'G

Project No.: 10416E — No. of Samples: 15 — Checked By:

Site: Landfill — Drilling Method: Auger — Date: 10-3-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Silty, very fine sand			No significant OVM readings
5					
10		Light cement			
15		Silty, very fine sand			
		Clay			
20		Fine, silty sand			
		Highly cemented sand			
25		Moderately cemented medium to fine sand and silt			
30					
35		Fine to medium sand, loose			
40		As above with medium pebble gravel			
		Cemented layer			
45		Fine to medium sand with medium pebble gravel			
50					

GEOTECHNICAL BORING LOG

BORING NO. LA-01

Project Name Williams I.R.P. Logged By TO'G

Project No. 10416E No. of Samples 15 Checked By

Site Landfill Drilling Method Auger Date 10-3-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
55		Fine to medium sand with fine to medium pebble gravel			
60					
65		As above with medium to coarse sand			
70					
75		Silty, very fine sand			
80		Sandy clay with fine pebble gravel			80.0 ft total depth

AV-F-HW02

GEOTECHNICAL BORING LOG

BORING NO. LA-02

Project Name Williams I.R.P. Logged By TO'G

Project No. 10416E No. of Samples 12 Checked By

Site Landfill Drilling Method Auger Date 10-4-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft (10 30 50)	Remarks
		Silty, very fine sand			No significant OVM readings
5		Lightly cemented sand and silt			
10		Silty, very fine sand			
15		As above with well rounded, fine pebble gravel			
		Lightly cemented as above			
20		Medium to coarse sand			
		Fine to medium silty sand			
25		Clayey sand			
30		Fine to medium silty sand			
35					
40		Fine to very fine silty sand			
45		Medium to coarse sand and fine pebble gravel			44.5 ft total depth

GEOTECHNICAL BORING LOG

BORING NO. LA-03

Project Name: Williams I.R.P.		Logged By: TO'G	
Project No.: 10416E	No. of Samples: 16	Checked By:	
Site: Landfill	Drilling Method: Auger	Date: 10-4-84	

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
		Very fine sand and silt			No significant OVM readings
5					
10		Fine clayey sand and silt			
		As above with minor gravel			
15		Fine sand and silt			
		As above with large pebble gravel			
20		Fine to medium sand			
		Medium to coarse sand with gravel			
		Fine to medium sand and silt			
25					
		Silty fine sand			
30					
		Clay with fine sand			
35					
		Silty fine to medium sand with small (1-2") interbeds of sandy clay			
40					
45					
		Medium to very coarse sand with gravel			
50					49.5 ft total depth

GEOTECHNICAL BORING LOG

BORING NO. LA-04

Project Name: Williams I.R.P. Logged By: TO'G

Project No. 10416E No. of Samples: 17 Checked By:

Site: Landfill Drilling Method: Auger Date: 10-5-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
5					No significant OVM readings
10		Fine to very fine sand and silt			
15					
		Medium to coarse sand & fine pebble gravel			
		Cemented as above			
20		Fine to medium sand			
25		As above with fine to medium pebble gravel			
		Fine to very fine sand and silt			
30					
		Fine to medium sand			
35					
		Clayey very fine sand and silt			
40		Coarse to very coarse sand and fine pebble gravel			
		Medium to coarse sand			
45					
50		Medium to coarse sand with fine to medium pebble gravel			

GEOTECHNICAL BORING LOG

BORING NO. LA-04

Project Name	Williams I.R.P.			Logged By	TO'G
Project No.	10416E	No. of Samples	17	Checked By	
Site	Landfill	Drilling Method	Auger	Date	10-5-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
55					
60		Medium to coarse sand with fine to medium pebble gravel			
65					
70					
75		Silty clay with fine pebble gravel - some areas of cementation			
80					81.0 ft total depth
85					

AV-F-HW02

GEOTECHNICAL BORING LOG

BORING NO. LA-05

Project Name Williams I.R.P.

Logged By TO'G

Project No. 10416E No. of Samples 12

Checked By

Site Landfill Drilling Method Auger

Date 10-5-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
5		Silty fine sand			No significant OVM readings
10					
		As above with fine pebble gravel			
15		Silty fine to medium sand			
		Gravel to cobble size			
20		Fine to medium sand with seams of fine to medium pebble gravel			
25					
30		Fine sand and silt			
35		Silty Clay			
40		Silty fine sand with sparse fine to medium pebble gravel			
45		Silty fine sand			
50		Fine to medium sand			

GEOTECHNICAL BORING LOG

BORING NO. LA-05

Project Name	Williams I.R.P.	Logged By	TO'G
Project No. 10416E	No. of Samples 12	Checked By	
Site Landfill	Drilling Method Auger	Date	10-5-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
55					
60					
		Medium to coarse sand with fine to coarse pebble gravel			
65					
70					
75					
		Clayey fine sand with fine to medium pebble gravel			
80					
		Sandy clay w/ fine to medium pebble gravel			
		Cemented clay			83.5 ft total depth
85					

GEOTECHNICAL BORING LOG

BORING NO. LA-06

Project Name Williams I.R.P. — Logged By TO'G

Project No. 10416E — No. of Samples 13 — Checked By

Site FPTA — Drilling Method Auger — Date 10-8-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
					No significant OVM readings
5					
		Silty fine to very fine sand			
10					
15					
		As above with medium pebble gravel			
20		Fine to very fine sand			
		Fine to coarse sand and fine pebble gravel - moist			
25					
		Fine to very fine sand and silt - light cement			
30		As above with no cement			
		As above with medium to coarse pebble gravel			
35		Clayey fine to very fine sand			
40		Fine to medium sand			
45		Medium to very coarse sand and fine to medium pebble gravel			
50					49.5 ft total depth

GEOTECHNICAL BORING LOG

BORING NO. LA-07

Project Name: Williams I.R.P.   Logged By: TO'G

Project No.: 10416E   No. of Samples: 18   Checked By:

Site: Landfill   Drilling Method: Auger   Date: 10-1-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft (10 30 50)	Remarks
5		Very fine sand and silt			No significant OVM readings
10		As above with light cement			
15		Very fine sand and silt			
20		As above with fine pebble gravel			
25		Clayey fine sand with fine pebble gravel			
30		Sandy clay			
35		Fine to medium sand Medium to coarse sand w/ medium pebble gravel Medium to coarse sand			
40		As above with fine pebble gravel			
45		Medium to very coarse sand with medium pebble gravel			
50					

GEOTECHNICAL BORING LOG

BORING NO. LA-07

Project Name Williams I.R.P. | Logged By TO'G

Project No. 10416E | No. of Samples 18 | Checked By

Site Landfill | Drilling Method Auger | Date 10-1-84

Depth (ft)	Graphic Log	Description	Sample Type	Blows/ft 10 30 50	Remarks
55		Medium to coarse sand and medium pebble gravel			
60					
65		Cobbles and medium to coarse sand			
70		Gravel with sandy clay			
75		Clay and medium to coarse pebble gravel			
80		Silty fine to very fine sand			80.5 ft total depth

APPENDIX E

Analytical Procedures

APPENDIX E
ANALYTICAL PROCEDURES AND
LABORATORY QUALITY CONTROL

E.1 ANALYTICAL PROCEDURES

The following subsections detail the procedures used to prepare and analyze samples for this project. The sample preparation procedures were taken from various sources and adapted to yield a processed sample capable of being analyzed by the standard water analyses methods of the United States Environmental Protection Agency (US EPA). Details of sample preparation are given, but only summaries of the analytical technique. Unless otherwise stated, all method numbers are US EPA methods from "Methods for Chemical Analysis of Water and Wastes", US EPA, EMSL, Cincinnati, Ohio 45268 EPA-600/4-79-019 March 1979.

E.1.1 Total Organic Halide

TBS

5g soil extr. w/ 50/50 acetone/hexane neutron activation per SW 842.

E.1.2 Phenolics, Total Recoverable

Approximately 20g soil is weighed accurately to one milligram, mixed with 400 mL deionized water, and the pH adjusted to 4 with 6N H_2SO_4. The sample is distilled and the distillate adjusted to pH 10 with a basic buffer. The buffer is prepared by dissolving 17g NH_4Cl in 143 mL conc. NH_4OH and then diluting to 250 mL with deionized water. The phenolic compounds in the distillate solution are reacted with 4-aminoantipyrine in the presence of potassium ferricyanide to produce a colored dye. The dye is extracted from the reaction solution with chloroform. The absorbance of samples and standards (prepared by adding known concentrations of phenol to water and then carrying through the process from distillation) in chloroform are read at 460 nm on a spectrophotometer. The method is EPA Method 420.1 (Spectrophotometric, Manual 4-AAP with Distillation).

E.1.3 Oil and Grease, Total Recoverable

The soil is first crumbled up so that there are no obvious large lumps and the material was free flowing. A 20g sample of soil is accurately weighed and transferred into a Soxhlet extractor cup. If the material is wet, then it is premixed with approximately 20g anhydrous sodium sulfate before being placed in the extractor. The material is extracted for at least 16 cycles with 300 mL Freon 113. The freon extract is concentrated to 10 mL with nitrogen blowdown and a Kuderna-Danish (KD) concentration apparatus. The freon concentrate is then placed in a dual beam infra-red spectrometer and the absorbance measured between 3,200 and 2,700 cm-1. The measurements are calibrated with a standard prepared from n-hexane, isooctane, and chlorobenzene in Freon 113. From the point of concentration the method is EPA Method 413.2 (Spectrophotometric, Infrared).

E.1.4 Metals

Approximately 5g of soil is weighed to microgram precision into a digestive vessel with 10 mL conc. HNO_3. The samples are gentle refluxed for 8 hours or until solids lightened in color. The samples are then brought up to a 100 mL volume for analysis. The sample is then analyzed by the appropriate flame atomic adsorption methodology for the element of interest. The instrument used is a dual beam background corrected Perkin-Elmer Model 460 Atomic Adsorption Instrument with parameters set up per EPA requirements. Standards are run at four levels, and the sample matrix is checked for signal enhancement or suppression by the method of standard addition.

Sample analysis was carried out by the procedures specified in "Methods for Chemical Analysis of Water and Wastes", USEPA, EMSL, Cincinnati, Ohio, 45268 EPA-600/4-79-019 March 1979. The specific method identifications are:

- Lead (Pb) - EPA Method 239.1
- Chromium (CR) - EPA Method 218.1
- Cadmium (Cd) - EPA Method 213.1
- Copper (Cu) - EPA Method 220.1

E.1.5 Cyanide

Samples for total cyanides analysis were prepared by accurately weighing 2g of soil and transferring into 200 mL of deionized water. The soil-water slurry is acidified with sulfuric acid, and the sample is distilled. Cyanide as HcN was absorbed in a sodium hydroxide scrubber.

The cyanide is converted to cyanogen chloride. The addition of the pyridine-barbituric acid reagent forms a colored complex which is measured at 620 nm.

Standards are prepared by distilling known concentrations of cyanide. The standard solutions were prepared in the same way as the samples. A standard curve is then prepared by plotting the concentration of the standard against the measured absorbance at 620 nm. This curve is then used to determine the concentration of the samples. (EPA Method 335.2)

E.1.6 Methyl-ethyl-ketone

TBS

E.1.7 E P Toxicity

EP toxicity metals are determined using methods from "Test Methods for Evaluating Solid Waste" (SW 846). One hundred grams of soil is added to 1600 mL of deionized water. Acetic acid is used to maintain the pH at 5.0. The sample is tumbled for 24 hours, then filtered through a 0.45 micron filter. The final volume is adjusted to 2,000 mL. A blank containing no soil is also run to verify freedom from contamination.

The extract is then digested by adding 5 ml of nitric acid to 100 ml of extract, reducing the volume to 50 ml, and bringing the volume back to 100 ml with deionized water.

Metals are determined using the appropriate EPA Method (206.2, 208.1, 213.1, 218.1, 239.1, 245.1, 270.2 and 272.1) employing atomic absorption spectrophotometry.

E.1.8 Ignitibility

Ignitibility is determined following "Test Methods for Evaluating Solid Waste" (SW 846) using a Pensky-Masters Closed Flash Tester.

E.2 QUALITY ASSURANCE SUMMARY

The results of the quality assurance/quality control activities are summed up in Table E-1. For each laboratory analysis, the total number of field samples is given followed by a listing for each of the quality control sample types. The "blanks" column lists the number of blanks run for a particular analysis, the detection limit for the analysis, and the number of blanks showing analytical results above the detection limit. Laboratory precision represents the results of duplicate analyses performed on the same sample. This includes preparative procedures. The statistical measure is the I statistic, which for duplicate analyses is equivalent to either the relative standard deviation or the coefficient of variation. The average I statistic for the number of duplicates listed is shown.

Table E-1. Summary of QA/QC Results as of December 14, 1984

Analysis	Number Performed	Blanks			Laboratory Precision			Field Precision			Spike Recovery		
		Number Analyzed	Detection Limit µg/g	Number Above D.L.	Number Analyzed	Average I[a] Statistic x100	CS x100	Number Analyzed	Average I Statistic x100	S x100	Number Analyzed	Average Percent Recovery	S
Total organic *halogens*	176	5	1	0	8	0	0	11	1	2	7	99	16
Oil and grease	185	12	50	0	12	1	2	12	4	9	11	100	4
Phenolics	178	14	0.5	0	14	0.3	1	12	0.4	1	12	80	9
Lead	189	9	2	0	8	10	7	11	10	7	11	100	10
Chromium	70	3	5	0	2	13	3	3	3	3	2	111	1
Cadmium	58	3	0.2	0	2	0	0	3	0	0	2	105	7
Copper	14												
Cyanide	14					Data not available 12/14/84							
MEK	22												
EP toxicity	4	1	Various	0	--	--	--	--	--	--	--	--	--
Ignitability	4	--	--	--	--	--	--	--	--	--	--	--	--
Totals	914	57	Various	0	46	4	2	52	4	4	45	99	8

[a]The I statistic is $I = |A-B|/(A+B)$ from EPA 600/4-79-019

AeroVironment and Acurex have submitted the laboratory quality assurance plan that is to be used by Acurex for all analyses performed under their Air Force contract (No. F33615-83-D-4000). All of the analyses of soil and waste samples from Williams AFB were completed in accordance with that plan. The reader is referred to the plan for more information on QA/QC procedures used in the laboratory during the sampling program: Environmental Quality Assurance Program Plan, Department 0900, April 1983, Acurex Corporation, Energy and Environmental Division.

APPENDIX F

Chain of Custody Forms

ACUREX Corporation / AeroVironment Inc.

Sheet 1 of 3 in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site ~~[illegible]~~ WILLIAMS AFB AV Project No. [illegible]

Date 9/24 Acurex Project No. [illegible]

Test Location FPTA Sampler(s) [illegible]

SAMPLES:

1. 810563 FP 14 01
2. 810577 FP 14 02
3. 810569 FP 14 03
4. 810572 FP 14 04
5. 810570 FP 14 05
6. 810573 FP 03 01
7. 810574 FP 03 02
8. 810575 FP 03 03
9. 810576 FP 03 04
10. 810578 FP 03 05
11. 810579 FP 03 06
12. 810580 FP 04 01

Field Supervisor DOUG TAYLOR AV Date 9/24/84

Samples Collected 1:00 PM TO 4:50 PM

Field Supervisor DOUG TAYLOR Date 9/24/84

Samples Released to FEDERAL EXPRESS Time 4:20 PM

Laboratory ______ Date ______

Samples Accepted ______ Time ______

Laboratory Acurex Date 9/27/84

Samples Accepted Efren A. Jablan

After Analysis Samples To Be: Disposed of ______

Saved for Storage ______

Project Engineer ______

ACUREX Corporation / AeroVironment Inc.

Sheet 2 of 5
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB AV Project No. 10416E

Date 9/24 Acurex Project No.

Test Location FPTA Sampler(s)

SAMPLES:

1. 810584 FP 04 032
2. 810581 FP 04 033
3. 810582 FP 04 034
4. 810585 FP 04 035
5. 810589 FP 04 036
6. 810595 FP 04 037
7. 810587 FP 04 038
8. 810583 FP QA 01
9. 810586 FP QA 02
10.
11.
12.

Field Supervisor DOUG TAYLOR AV Date 9/24/84
Samples Collected 1:00 PM TO 4:50 PM

Field Supervisor DOUG TAYLOR Date 9/24/84
Samples Released to FEDERAL EXPRESS Time 4:50 PM

Laboratory Date
Samples Accepted Time

Laboratory Acurex Date 9/27/84
Samples Accepted [signature]

After Analysis Samples To Be: Disposed of
Saved for Storage

Project Engineer

ACUREX Corporation / AeroVironment Inc.

Sheet 3 of 5 in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB

AV Project No. 10416 E

Date 9/25

Acurex Project No.

Test Location FPTA

Sampler(s) [illegible]

SAMPLES:

1. 810590 FP 05 01
2. 810591 FP 05 02
3. 810596 [illegible]
4. 810597 [illegible]
5. 810592 [illegible]
6. 810593 [illegible]
7. 810598 [illegible]
8. 810599 [illegible]
9. 810600 [illegible]
10. 810601 [illegible]
11. 810605 [illegible]
12. 810606 [illegible]

Field Supervisor DOUG TAYLOR AV Date 9/25/84

Samples Collected 8 00 AM TO 5 00 PM

Field Supervisor DOUG TAYLOR Date 9/26/84

Samples Released to FEDERAL EXPRESS Time 4:20 PM

Laboratory Date

Samples Accepted Time

Laboratory Acurex Date 9/27/84

Samples Accepted [signature]

After Analysis Samples To Be: Disposed of

Saved for Storage

Project Engineer

ACUREX Corporation / AeroVironment Inc.

Sheet 4 of 5 in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB AV Project No. 10416 E

Date 9/25 Acurex Project No.

Test Location FPTA Sampler(s)

SAMPLES:

1. 810607 FP 07 02
2. 810608 FP 07 03
3. 810610 FP 07 04
4. 810611 FP 07 05
5. 810615 FP 08 01
6. 810613 FP 08 02
7. 810614 FP 08 03
8. 810616 FP 08 04
9. 810617 FP 08 05
10. 810618 FP 08 06
11. 810620 FP 08 07
12. 810619 FP 08 08

Field Supervisor DOUG TAYLOR Date 9/25/84

Samples Collected 8:00 AM – 5:00 PM

Field Supervisor DOUG TAYLOR Date 9/25/84

Samples Released to FEDERAL EXPRESS Time 4:30 PM

Laboratory Date

Samples Accepted Time

Laboratory Acurex Date 9/27/84

Samples Accepted Efren D. Jablon

After Analysis Samples To Be: Disposed of ✓

Saved for Storage

Project Engineer

ACUREX Corporation / AeroVironment Inc.

Sheet 5 of 5 in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB AV Project No. 10416E

Date 9/25 Acurex Project No. ______

Test Location FPTA Sampler(s) ______

SAMPLES:

1. 810594 FP QA 03
2. 810601 FP QA 04
3. 810602 FP QA 05
4. ______
5. ______
6. ______
7. ______
8. ______
9. ______
10. ______
11. ______
12. ______

Field Supervisor DOUG TAYLOR Date 9/25/84
Samples Collected 8 00 AM - 5 00 PM

Field Supervisor DOUG TAYLOR Date 9/25/84
Samples Released to FEDERAL EXPRESS Time 4 30 PM

Laboratory ______ Date ______
Samples Accepted ______ Time ______

Laboratory Acurex Date 9/27/84
Samples Accepted Glen A. Jablan

After Analysis Samples To Be: Disposed of ______
Saved for Storage ______

Project Engineer ______

ACUREX Corporation / AeroVironment Inc.

Sheet ___ of ___
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB

AV Project No. [illegible]

Date 9/27

Acurex Project No. ___

Test Location FPTL

Sampler(s) [illegible]

SAMPLES:

1. 810634 FP 10 01
2. 810637 FP 10 02
3. 810635 FP 10 03
4. 810633 FP 10 04
5. 810636 FP 10 05
6. 810639 FP 10 06
7. 810640 FP 10 07
8. 810643 FP 11 01
9. 810642 FP 11 02
10. 810645 FP 11 03
11. 810646 FP 11 04
12. 810649 FP 11 05

Field Supervisor DAVE TAYLOR Date 9/27/84
Samples Collected 8:00 AM - 5:00 PM

Field Supervisor DAVE TAYLOR Date 9/27
Samples Released to FEDERAL EXPRESS Time [illegible]:30 PM

Laboratory ___ Date ___
Samples Accepted ___ Time ___

Laboratory Acurex Date 9/28/84
Samples Accepted Ellen A. Jablon

After Analysis Samples To Be: Disposed of ___
Saved for Storage ___

Project Engineer ___

ACUREX Corporation / AeroVironment Inc.

Sheet 2 of 4
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site [illegible] AFB

AV Project No. 1041[illegible]

Date 9/27

Acurex Project No.

Test Location FP-A

Sampler(s) TAYLOR O'HARA

SAMPLES:

1. 810647 FP 12 01
2. 810650 FP 12 02
3. 810648 FP 12 03
4. 810651 FP 12 04
5. 810652 FP 12 05
6. 810655 FP 13 01
7. 810653 FP 13 02
8. 810656 FP 13 03
9. 810654 FP 13 04
10. 810657 FP 13 05
11. 810658 FP 13 06
12. 810659 FP 15 01

Field Supervisor DOUG TAYLOR Date 9 27 84

Samples Collected 8 00 AM - 5 00 PM

Field Supervisor DOUG TAYLOR Date 9/27

Samples Released to FEDERAL EXPRESS Time 6:30 PM

Laboratory Date

Samples Accepted Time

Laboratory Acurex Date 9/28/84

Samples Accepted Glen A. Sablan

After Analysis Samples To Be: Disposed of

Saved for Storage

Project Engineer

ACUREX Corporation / AeroVironment Inc.

Sheet ___ of ___
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site ______ AV Project No. ______

Date ______ Acurex Project No. ______

Test Location ______ Sampler(s) ______

SAMPLES:

1.	810661 FP 15 02	7.	810667 FP 15 08
2.	810662 FP 15 03	8.	810641 FP [illegible]
3.	810660 FP 15 04	9.	810663 FP [illegible]
4.	810664 FP 15 05	10.	
5.	810665 FP 15 06	11.	
6.	810665 FP 15 07	12.	

Field Supervisor [illegible] Date [illegible]

Samples Collected [illegible]

Field Supervisor [illegible] Date [illegible]

Samples Released to FEDERAL EXPRESS Time [illegible]

Laboratory ______ Date ______

Samples Accepted ______ Time ______

Laboratory Acurex Date 9/24/84

Samples Accepted [illegible]

After Analysis Samples To Be: Disposed of ______
Saved for Storage ______

Project Engineer ______

[illegible]

ACUREX Corporation / AeroVironment Inc.

Sheet 1 of 5 in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site: WILLIAMS AFB
AV Project No.: 10415
Date: 9/25 & 9/27
Acurex Project No.:
Test Location: FPTA
Sampler(s): TAYLOR

SAMPLES:

1. 810621 FP 09 01
2. 810622 FP 09 02
3. 810623 FP 09 03
4. 810624 FP 09 04
5. 810625 FP 09 05
6. 810626 FP 09 06
7. 810627 FP 09 07
8. 810628 FP 09 08
9. 810629 FP 09 09
10. 810631 FP 09 10
11. 810663 FP 09 11
12.

Field Supervisor: DOUG TAYLOR Date: 9/27
Samples Collected: 8:00 AM - 5:00 PM

Field Supervisor: DOUG TAYLOR Date: 9/27
Samples Released to: FEDERAL EXPRESS Time: 6:30 PM

Laboratory: Date:
Samples Accepted: Time:

Laboratory: Acurex Date: 9/28/84
Samples Accepted: Efren A. Jablan

After Analysis Samples To Be: Disposed of
Saved for Storage

Project Engineer:

Acurex Corporation / AeroVironment Inc.

Sheet ___ of ___ in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site ______ AV Project No. ______

Date ______ Acurex Project No. ______

Test Location ______ Sampler(s) ______

SAMPLES:

1. 810674 L1 01 01	7. 810681 L1 02 01
2. 810675 L1 01 02	8. 810683 L1 02 02
3. 810673 L1 01 03	9. 810682 L1 02 03
4. 810676 L1 01 04	10. 810685 L1 02 04
5. 810679 L1 01 05	11. 810686 L1 02 05
6. 810680 L1 01 06	12. 810669

Field Supervisor ______ Date ______

Samples Collected ______ AM - ______ PM

Field Supervisor DOUG TAYLOR Date 9/26/84

Samples Released to FEDERAL EXPRESS Time 5 05

Laboratory ______ Date ______

Samples Accepted ______ Time ______

Laboratory Acurex Date 9/29/84

Samples Accepted [signature]

After Analysis Samples To Be: Disposed of ______

Saved for Storage ______

Project Engineer ______

ACUREX Corporation / AeroVironment Inc.

Sheet [illegible] of ___ in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site [illegible] AV Project No. [illegible]

Date 9/23/84 Acurex Project No. ___

Test Location [illegible] Sampler(s) [illegible]

SAMPLES:

1. 810672 LI 09 02
2. 810670 LI 09 03
3. 810673 LI 09 04
4. 810677 LI 09 05
5. 810671 LI QA 01
6. 810684 LI QA 02
7. ___
8. ___
9. ___
10. ___
11. ___
12. ___

Field Supervisor [illegible] Date [illegible]

Samples Collected [illegible]

Field Supervisor DOUG TAYLOR Date 9/28/84

Samples Released to FEDERAL EXPRESS Time 5 05

Laboratory ___ Date ___

Samples Accepted ___ Time ___

Laboratory Acurex Date 9/29/84

Samples Accepted [signature]

After Analysis Samples To Be: Disposed of ___

Saved for Storage ___

Project Engineer ___

Acurex Corporation / AeroVironment Inc.

Sheet 1 of ___
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site: Williams AFB
AV Project No.: 10416E
Date: 10/1
Acurex Project No.:
Test Location: Landfill
Sampler(s): Doug Taylor / Tim O'Hara

SAMPLES:

1. 810689 LA 07 01
2. 810690 LA 07 02
3. 810687 LA 07 03
4. 810688 LA 07 04
5. 810691 LA 07 05
6. 810692 LA 07 06
7. 810695 LA 07 07
8. 810693 LA 07 08
9. 810696 LA 07 09
10. 810697 LA 07 10
11. 810698 LA 07 11
12. 810701 LA 07 12

Field Supervisor: Doug Taylor Date: 10/1/84
Samples Collected: 9:30 AM - 3:00 PM

Field Supervisor: ___ Date: ___
Samples Released to: ___ Time: ___

Laboratory: ___ Date: ___
Samples Accepted: ___ Time: ___

Laboratory: Acurex Date: 10/15/84
Samples Accepted: [signature]

After Analysis Samples To Be: Disposed of ___
Saved for Storage ___

Project Engineer ___

ACUREX Corporation / AeroVironment Inc.

Sheet 1 of ___
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB AV Project No. [illegible]

Date 10/[illegible] Acurex Project No.

Test Location LANDFILL Sampler(s) DOUG TAYLOR / TIM [illegible]

SAMPLES:

1. 810699 LA 07 13
2. 810700 LA 07 14
3. 810702 LA 07 15
4. 810703 LA 07 16
5. 810701 LA 07 17
6. 810691 [illegible] QA 01
7.
8.
9.
10.
11.
12.

Field Supervisor DOUG TAYLOR Date 10/[illegible] 84
Samples Collected 9:30 - 3:00 PM

Field Supervisor ___ Date ___
Samples Released to ___ Time ___

Laboratory ___ Date ___
Samples Accepted ___ Time ___

Laboratory Acurex Date 10/5/84
Samples Accepted [signature]

After Analysis Samples To Be: Disposed of ___
Saved for Storage ___

Project Engineer ___

Acurex Corporation / AeroVironment Inc.

Sheet 3 of ___ in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB
AV Project No. 10416 E
Date 10/2
Acurex Project No.
Test Location LFSA
Sampler(s) DOUG TAYLOR TIM OGARA

SAMPLES:

1. 810708 L1 03 01	7. 810711 L1 03 07
2. 810705 L1 03 02	8. 810714 L1 03 08
3. 810706 L1 03 03	9. 810712 L1 03 09
4. 810709 L1 03 04	10. 810715 L1 03 10
5. 810710 L1 03 05	11. 810716 L1 03 11
6. 810713 L1-03-06 TAG MISPLACED	12. 810719 L1 03 12

Field Supervisor ___ Date ___
Samples Collected ___

Field Supervisor ___ Date ___
Samples Released to ___ Time ___

Laboratory ___ Date ___
Samples Accepted ___ Time ___

Laboratory Acurex Date 10/5/86
Samples Accepted [signature]

After Analysis Samples To Be: Disposed of ___
Saved for Storage ___

Project Engineer ___

ACUREX Corporation / AeroVironment Inc.

Sheet 4 of ___
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB — AV Project No. 10416 E

Date 10/2 — Acurex Project No. ___

Test Location LFSA — Sampler(s) DOUG TAYLOR / TIM O'GARA

SAMPLES:

1. 810717 LI 04 01
2. 810720 LI 04 02
3. 810713 LI 04 03
4. 810721 LI 04 04
5. 811031 LI 04 05
6. 811034 LI 05 01
7. 811037 LI 05 02
8. 811029 LI 05 03
9. 811032 LI 05 04
10. 811030 LI 05 05
11. 811033 LI 06 01
12. ~~811039~~ ~~LF~~ 06 - 01 ~~02~~ - TAG MISMARKED

Field Supervisor ___ Date ___
Samples Collected ___

Field Supervisor ___ Date ___
Samples Released to ___ Time ___

Laboratory ___ Date ___
Samples Accepted ___ Time ___

Laboratory Acurex Date 10/5/84
Samples Accepted Efrem A. Jablon

After Analysis Samples To Be: Disposed of ___
Saved for Storage ___

Project Engineer ___

Acurex Corporation / AV AeroVironment Inc.

Sheet 5 of ___ in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site Hill AFB | AV Project No. 104 | Date 10/2 | Acurex Project No. | Test Location LFS1 | Sampler(s)

SAMPLES:

1. 811039 L1 06 02	7. 812171 L1 07 05
2. 811033 L1 06 03	8. 810707 L1 03A 03
3. 811036 L1 07 01	9. 811026 L1 QA 04
4. 812163 L1 07 02	10. 811038 L1 QA 05
5. 812169 L1 07 03	11.
6. 812172 L1 07 04	12.

Field Supervisor ______ Date ______
Samples Collected ______

Field Supervisor ______ Date ______
Samples Released to ______ Time ______

Laboratory ______ Date ______
Samples Accepted ______ Time ______

Laboratory Acurex Date 10/5/84
Samples Accepted Eileen A. Dahlan

After Analysis Samples To Be: Disposed of ______
Saved for Storage ______

Project Engineer ______

ACUREX Corporation / AeroVironment Inc.

Sheet 6 of ___ in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB — AV Project No. 10416 E

Date 10/3 — Acurex Project No. ___

Test Location LANDFILL — Sampler(s) DOUG TAYLOR / TIM O'[illegible]

SAMPLES:

1. 812170 LA 01 01
2. 812173 LA 01 02
3. 811526 LA 01 03
4. 811529 LA 01 04
5. 811527 LA 01 05
6. 811530 LA 01 06
7. 811523 LA 01 07
8. 811531 LA 01 08
9. 811148 LA 01 09
10. 811151 LA 01 10
11. 811149 LA 01 11
12. 811152 LA 01 12

Field Supervisor ___ Date ___
Samples Collected ___

Field Supervisor ___ Date ___
Samples Released to ___ Time ___

Laboratory ___ Date ___
Samples Accepted ___ Time ___

Laboratory Acurex Date 10/5/84
Samples Accepted [signature]

After Analysis Samples To Be: Disposed of ___
Saved for Storage ___

Project Engineer ___

ACUREX Corporation / AeroVironment Inc.

Sheet 7 of ___
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB AV Project No. 10916E

Date 10/3 + 10/4 Acurex Project No. ____

Test Location LANDFILL Sampler(s) DOUG TAYLOR / TIM O'HARA

SAMPLES:

1. 811150 LA 01 13
2. 811153 LA 01 14
3. 811154 LA 01 15
4. ____
5. ____
6. ____
7. ____
8. ____
9. ____
10. ____
11. ____
12. ____

Field Supervisor ____ Date ____
Samples Collected ____

Field Supervisor ____ Date ____
Samples Released to ____ Time ____

Laboratory ____ Date ____
Samples Accepted ____ Time ____

Laboratory Acurex Date 10/5/84
Samples Accepted Ellen S. Jablow

After Analysis Samples To Be: Disposed of ____
Saved for Storage ____

Project Engineer ____

ACUREX Corporation / AeroVironment Inc.

Sheet ___ of ___
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB AV Project No. 10416E

Date ______ Acurex Project No. ______

Test Location ______ Sampler(s) ______

SAMPLES:

1. 811157 LA 02 01	7. 811164 LA 02 07
2. 811156 LA 02 02	8. 811162 LA 02 08
3. 811158 LA 02 03	9. 811165 LA 02 09
4. 811160 LA 02 04	10. 811166 LA 02 10
5. 811159 LA 02 05	11. 811169 LA 02 11
6. 811163 LA 02 06	12. 811167 LA 03 .01

Field Supervisor ______ Date ______
Samples Collected ______

Field Supervisor ______ Date ______
Samples Released to ______ Time ______

Laboratory ______ Date ______
Samples Accepted ______ Time ______

Laboratory Acurex Date 10/5/84
Samples Accepted [signature]

After Analysis Samples To Be: Disposed of ______
Saved for Storage ______

Project Engineer ______

ACUREX Corporation / AeroVironment Inc.

Sheet ___ of ___
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site ______________________ AV Project No. ______________________

Date ______________________ Acurex Project No. ______________________

Test Location ______________________ Sampler(s) ______________________

SAMPLES:

1. 811170 LA 03 02
2. 811168 LA 03 03
3. 811172 LA 03 04
4. 811178 LA 03 05
5. 811175 LA 03 06
6. 811173 LA 03 07
7. 811176 LA 03 8
8. 811174 LA 03 9
9. 811177 LA 03 10
10. 811179 LA 03 11
11. 811182 LA 03 12
12. 811181 LA 03 13

Field Supervisor ______________________ Date ____________
Samples Collected ______________________

Field Supervisor ______________________ Date ____________
Samples Released to ______________________ Time ____________

Laboratory ______________________ Date ____________
Samples Accepted ______________________ Time ____________

Laboratory Acurex Date 10/5/84
Samples Accepted Efren A. Jabalan

After Analysis Samples To Be: Disposed of ______________________
Saved for Storage ______________________

Project Engineer ______________________

ACUREX Corporation / AeroVironment Inc.

Sheet ___ of ___
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site ____________ AV Project No. ____________

Date ____________ Acurex Project No. ____________

Test Location ____________ Sampler(s) ____________

SAMPLES:

1. 811187 LA 03 14 7. ____________
2. 811155 LA QA 02 8. ____________
3. 811171 LA QA 03 9. ____________
4. 811184 LA QA 04 10. ____________
5. ____________ 11. ____________
6. ____________ 12. ____________

Field Supervisor ____________ Date ____________
Samples Collected ____________

Field Supervisor ____________ Date ____________
Samples Released to ____________ Time ____________

Laboratory ____________ Date ____________
Samples Accepted ____________ Time ____________

Laboratory Acurex Date 10/5/84
Samples Accepted Efren A. Jablan

After Analysis Samples To Be: Disposed of ____________
Saved for Storage ____________

Project Engineer ____________

AV-F-HW01

ACUREX Corporation / AeroVironment Inc.

Sheet 1 of 4 in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site: WILLIAMS AFB
AV Project No.: [illegible]

Date: 10/5 & 10/8
Acurex Project No.:

Test Location: LANDFILL
Sampler(s): TAYLOR / [illegible]

SAMPLES:

1. 811185 LA 04 01
2. 811188 LA 04 02
3. 811189 LA 04 03
4. 810842 LA 04 04
5. 810845 LA 04 05
6. 810843 LA 04 06
7. 810846 LA 04 07
8. 810847 LA 04 08
9. 810844 LA 04 09
10. 811190 LA 04 10
11. 811193 LA 04 11
12. 811191 LA 04 12

Field Supervisor: DOUG TAYLOR
Date: 10/5 & 10/8
Samples Collected: 8:00 - 5:00

Field Supervisor:
Date:
Samples Released to:
Time:

Laboratory:
Date:
Samples Accepted:
Time:

Laboratory: [illegible]
Date: [illegible]
Samples Accepted: [illegible]

After Analysis Samples To Be:
Disposed of
Saved for Storage

Project Engineer:

AV-F-HW01

ACUREX Corporation / AeroVironment Inc.

Sheet 1 of 4 in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site [illegible] AFB | AV Project No. [illegible]

Date 10/3 - 10/5 | Acurex Project No. ____

Test Location LANDFILL | Sampler(s) TAYLOR / [illegible]

SAMPLES:

1. 811194 LA 04 13
2. 811195 LA 04 14
3. 811192 LA 04 15
4. 811376 LA 04 16
5. 811379 LA 05 01
6. 811377 LA 05 02
7. 811380 LA 05 03
8. 811378 LA 05 04
9. 811631 LA 05 05
10. 811637 LA 05 06
11. 811635 LA 05 07
12. 811633 LA 05 08

Field Supervisor DOUG TAYLOR Date 10/4 & 10/5
Samples Collected 8:00 - 5:00

Field Supervisor ____ Date ____
Samples Released to ____ Time ____

Laboratory ____ Date ____
Samples Accepted ____ Time ____

Laboratory [illegible] Date [illegible]
Samples Accepted [illegible]

After Analysis Samples To Be: Disposed of ____
Saved for Storage ____

Project Engineer ____

AV [illegible]

Acurex Corporation / AeroVironment Inc.

Sheet 3 of 4 in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB — AV Project No. 10416E

Date 10/3 ? 10/5 — Acurex Project No. ______

Test Location LANDFILL — Sampler(s) TAYLOR / O'HARA

SAMPLES:

1.	811639 LA 05 09	7.	811066 LA 06 04
2.	811633 LA 05 10	8.	811069 LA 06 05
3.	811064 LA 05 11	9.	811070 LA 06 06
4.	811067 LA 06 01	10.	811071 LA 06 07
5.	811065 LA 06 02	11.	811074 LA 06 08
6.	811063 LA 06 03	12.	811072 LA 06 09

Field Supervisor DOUG TAYLOR — Date 10/3 ? 10/5
Samples Collected 8:00 - 5:00

Field Supervisor ______ Date ______
Samples Released to ______ Time ______

Laboratory ______ Date ______
Samples Accepted ______ Time ______

Laboratory [illegible] — Date [illegible]
Samples Accepted [illegible] Ferguson

After Analysis Samples To Be: Disposed of ______
Saved for Storage ______

Project Engineer ______

AV-F-HW01

ACUREX Corporation / AeroVironment Inc.

Sheet 4 of 4
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

Site WILLIAMS AFB
AV Project No. 10416E
Date 10/5 & 10/8
Acurex Project No.
Test Location LANDFILL
Sampler(s) TAYLOR / O GARA

SAMPLES:

1. 811075 LA 06 10
2. 811076 LA 06 11
3. 811079 LA 06 12
4. 811188 LA QA 05
5. 811381 LA QA 06
6. 811073 LA QA 07
7.
8.
9.
10.
11.
12.

Field Supervisor DOUG TAYLOR Date 10/5 & 10/8
Samples Collected 8:00 - 5:00

Field Supervisor Date
Samples Released to Time

Laboratory Date
Samples Accepted Time

Laboratory [illegible] Date [illegible]
Samples Accepted [illegible]

After Analysis Samples To Be: Disposed of
Saved for Storage

Project Engineer

ACUREX Corporation / AeroVironment Inc.

Sheet ___ of ___ in this shipment

SAMPLE HANDLING LOG

Chain of Custody

8410-012

Site ______ AV Project No. ______

Date ______ Acurex Project No. ______

Test Location ______ Sampler(s) ______

SAMPLES:

1.	811082 SW 01 01	7.	811087 SW 04 01
2.	811083 SW 01 02	8.	811091 SW 04 02
3.	811077 SW 02 01	9.	811086 SW 05 01
4.	811080 SW 02 02	10.	811084 SW 05 02
5.	811078 SW 03 01	11.	811089 SW 06 01
6.	811081 SW 03 02	12.	811092 SW 06 02

Field Supervisor ______ Date ______

Samples Collected 7 am - 3 pm

Field Supervisor ______ Date ______

Samples Released to ______ Time ______

Laboratory ______ Date ______

Samples Accepted ______ Time ______

Laboratory Acurex Date 10/12/8_

Samples Accepted M. Claire Ferguson

After Analysis Samples To Be: Disposed of X

Saved for Storage ______

Project Engineer ______

ACUREX Corporation / AeroVironment Inc.

Sheet 1 of 1 in this shipment

SAMPLE HANDLING LOG

Chain of Custody

8410-017

Site WILLIAMS AFB AV Project No. 1041GE

Date 12/10 Acurex Project No.

Test Location WASTE DRUMS Sampler(s) TAYLOR

SAMPLES:

1. 811106 WA 01
2. 811109 WA 02
3. 811102 WA 03
4. 811105 WA 04
5.
6.
7.
8.
9.
10.
11.
12.

Field Supervisor DOUG TAYLOR Date 12/10
Samples Collected 3 00 PM - 5 00 PM

Field Supervisor DOUG TAYLOR Date 12/15
Samples Released to FEDERAL EXPRESS Time 11:30

Laboratory Date
Samples Accepted Time

Laboratory Acurex Date 12/16/84
Samples Accepted [illegible signature]

After Analysis Samples To Be: Disposed of ✓
Saved for Storage

Project Engineer

AV F [illegible]

ACUREX Corporation / AeroVironment Inc.

Sheet ___ of ___
in this shipment

SAMPLE HANDLING LOG

Chain of Custody

841 0-012

Site ______ AV Project No. ______

Date ______ Acurex Project No. ______

Test Location ______ Sampler(s) ______

SAMPLES:

1. 811083 SW QA 01
2. 811083 SW QA 02
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.

Field Supervisor ______ Date ______
Samples Collected ______

Field Supervisor ______ Date ______
Samples Released to ______ Time ______

Laboratory ______ Date ______
Samples Accepted ______ Time ______

Laboratory Acurex Date 12/12/81
Samples Accepted B. Clair Ferguson

After Analysis Samples To Be: Disposed of X
Saved for Storage ______

Project Engineer ______

AV-F-HW01

ACUREX Corporation / AeroVironment Inc.

Sheet ___ of ___ in this shipment

SAMPLE HANDLING LOG

Chain of Custody

8410-012

Site ______________________ AV Project No. ______________________

Date ______________________ Acurex Project No. ______________________

Test Location ______________________ Sampler(s) ______________________

SAMPLES:

1. 811100 NW 01 01
2. 811095 NW 02 01
3. 811098 NW 02 02
4. 811099 NW 03 01
5. 811103 NW 03 02
6. 811101 NW 04 01
7. 811104 NW 04 02
8. 811096 NW QA 01
9. ______________________
10. ______________________
11. ______________________
12. ______________________

Field Supervisor ______________________ Date ______________________
Samples Collected ______________________

Field Supervisor ______________________ Date ______________________
Samples Released to ______________________ Time ______________________

Laboratory ______________________ Date ______________________
Samples Accepted ______________________ Time ______________________

Laboratory Acurex Date [illegible]
Samples Accepted [illegible]

After Analysis Samples To Be: Disposed of X
Saved for Storage ______________________

Project Engineer ______________________

Acurex Corporation / AeroVironment Inc.

Sheet ___ of ___ in this shipment

8410-012

SAMPLE HANDLING LOG

Chain of Custody

Site ________ AV Project No. ________

Date ________ Acurex Project No. ________

Test Location ________ Sampler(s) ________

SAMPLES:

1. 811094 FP 01 01
2. 811097 FP 01 02
3. 811090 FP 02 01
4. 811093 FP 02 02
5.
6.
7.
8.
9.
10.
11.
12.

Field Supervisor ________ Date ________
Samples Collected ________

Field Supervisor ________ Date ________
Samples Released to ________ Time ________

Laboratory ________ Date ________
Samples Accepted ________ Time ________

Laboratory Acurex Date 10/13/84
Samples Accepted M. Claire Ferguson

After Analysis Samples To Be: Disposed of X
Saved for Storage ________

Project Engineer ________

AV-F-HW01

APPENDIX G

Laboratory Data

CERTIFIED ANALYTICAL REPORT

November 12, 1984

For

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
Monrovia, CA 91016

By

Acurex Corporation
555 Clyde Avenue
Mountain View, CA 94039

ACUREX Corporation

ACUREX Corporation

Energy & Environmental Division

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
Monrovia, CA 91016

November 12, 1984
Acurex ID#: 8410-007
Client PO#: 306600.82

Subject: The analysis of 42 Soil Samples from Williams Air Force Base for Total Recoverable Phenols, Oil and Grease, Lead, Cadmium, Chromium and Total Organic Halogens. Samples Received 9/27/84.

The 42 soil samples were analyzed for total recoverable phenolic compounds using EPA Method 420.1, adapted for use with soil. Twenty grams of soil were distilled with 400 mL dionized water and then analyzed as specified by the method.

The samples were analyzed for oil and grease using EPA Method 413.2, adapted for use with soil. Twenty grams of soil were extracted and then analyzed as specified by the method.

The samples were analyzed for lead, cadmium and chromium using EPA Methods 239, 213 and 218, respectively, adapted for use with soil. Five grams of soil were digested in nitric acid and then analyzed as specified in the methods.

The samples were analyzed for total organic halogens using EPA Method 9020, adapted for use with soil.

The results of the analyses specified above are presented in Table 1.

The quality assurance information for all sample analyses is reported in Table 2.

Prepared by: ______________________
Ray Kaminsky, Ph.D.
Project Manager

Approved by: Greg Nicoll
Greg Nicoll
Manager, Inorganic Chemistry

cc: Dean Wolbach

Table 1. Analytical Results of Soil Samples

Acurex No. 8410-007	Sample No.	Total Recoverable Phenolics (µg/g)	Oil and Grease (µg/g)	Lead (µg/g)	Chromium (µg/g)	Cadmium (µg/g)	Total Organic Halogens (µg/g)
-1	810687	ND	ND	9	11	ND	ND
-2	810688	ND	ND	8	13	ND	ND
-3	810692	ND	ND	7	9	ND	ND
-4	810696	ND	ND	7	9	ND	ND
-5	810701	ND	ND	4	6	ND	ND
-6	810702	ND	ND	8	13	ND	ND
-7	810704	ND	ND	7	17	ND	ND
-8	811148	ND	ND	9	17	ND	ND
-9	811152	ND	ND	7	10	ND	ND
-10	811154	ND	ND	7	14	ND	ND
-11	811158	ND	ND	8	10	ND	ND
-12	811163	ND	ND	12	17	ND	ND
-13	811165	ND	ND	9	11	ND	ND
-14	811168	ND	ND	11	26	ND	ND
-15	811169	ND	ND	6	8	ND	ND
-16	811174	ND	ND	8	15	ND	ND
-17	811175	ND	ND	9	15	ND	ND
-18	811182	ND	ND	8	7	ND	ND
-19	811187	ND	ND	5	6	ND	ND
-20	810706	ND	ND	520	--	--	ND
-21	810711	0.5	340	700	--	--	ND
-22	811712	2.3	1,400	890	--	--	8
-23	810713	ND	430	680	--	--	ND
-24	810714	4.7	720	1,100	--	--	ND
-25	810715	7.5	2,500	660	--	--	4
-26	810716	ND	70	260	--	--	ND
-27	810717	ND	ND	16	--	--	ND
-28	810718	ND	ND	7	--	--	ND
-29	810719	ND	320	220	--	--	3

Table 1. Analytical Results of Soil Samples (Continued)

Acurex No. 8410-007	Sample No.	Total Recoverable Phenolics (μg/g)	Oil and Grease (μg/g)	Lead (μg/g)	Chromium (μg/g)	Cadmium (μg/g)	Total Organic Halogens (μg/g)
-30	810720	ND	ND	12	--	--	ND
-31	810721	ND	ND	6	--	--	ND
-32	811023	ND	ND	11	--	--	ND
-33	811031	ND	ND	5	--	--	ND
-34	811033	ND	ND	7	--	--	ND
-35	811034	ND	340	56	--	--	ND
-36	810635	1.0	110	51	--	--	ND
-37	811036	ND	ND	60	--	--	ND
-38	811037	ND	70	23	--	--	ND
-39	811039	ND	ND	11	--	--	ND
-40	812168	ND	ND	15	--	--	ND
-41	812169	ND	ND	7	--	--	ND
-42	810171	ND	ND	8	--	--	ND
Detection Limit (μg/g)		0.5	50	2	5	0.2	1

Table 2. Quality Assurance Data

PHENOLICS

Method blanks (μg/g)

1	<0.5	3	<0.5
2	<0.5	4	<0.5

Spikes (percent recovery, spiked at 2.0 μg/g)

810721	82	811039	82

Duplicates (μg/g)

810688	<0.5, <0.5	811037	<0.5, <0.5
810713	<0.5, <0.5	811168	<0.5, <0.5

OIL AND GREASE

Method blanks (μg/g)

1	<50	3	<50
2	<50		

Spikes (percent recovery, spiked at 95 μg/g)

810688	90	812169	104
810696	100		

Duplicates (μg/g)

810688	<50, <50	812169	<50, <50
811169	<50, <50		

Table 2. Quality Control Data
(Continued)

LEAD

Method Blanks (μg/g)

1	<2	2	<2

Spikes (percent recovery)

811175	110[a]	812168	95[a]
811175	112[b]		

[a] Spiked at 20 ug/g
[b] Spiked at 50 ug/g

Duplicates (μg/g)

810702	8, 13	810711	700, 620

CHROMIUM

Method Blank (μg/g)

1	<5

Spikes (percent recovery, spiked at 50 μg/g)

811175	112

Duplicate (μg/g)

810702	13, 17

Table 2. Quality Control Data
(Continued)

CADMIUM

Method Blank (μg/g)

1	<0.2

Spikes (percent recovery, spiked at 2.0 μg/g)

811175	100

Duplicate (μg/g)

810702	<0.2, <0.2

TOTAL ORGANIC HALOGENS

Method Blanks

1	<1	2	<1

Spikes (percent recovery)

810692[a]	83	810696[b]	86

[a] Spiked at 6 μg/g
[b] Spiked at 5 μg/g

Duplicate (μg/g)

810687	<1	810688	<1

CERTIFIED ANALYTICAL REPORT

November 2, 1984

For

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
Monrovia, CA 91016

By

Acurex Corporation
555 Clyde Avenue
Mountain View, CA 94039

ACUREX Corporation

ACUREX Corporation

Energy & Environmental Division

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
Monrovia, CA 91016

November 2, 1984
Acurex ID#: 8409-033
Client PO#: 306600.82

Subject: The analysis of 77 Soil Samples from Williams Air Force Base for Total Recoverable Phenols, Oil and Grease, Lead, and Total Organic Halogens. Samples Received 9/27/84.

The 77 soil samples were analyzed for total recoverable phenolic compounds using EPA Method 420.1, adapted for use with soil. Twenty grams of soil were distilled with 400 mL dionized water and then analyzed as specified by the method.

The samples were analyzed for oil and grease using EPA Method 413.2, adapted for use with soil. Twenty grams of soil were extracted and then analyzed as specified by the method.

The samples were analyzed for lead using EPA Method 239, adapted for use with soil. Five grams of soil were digested in nitric acid and then analyzed as specified in the method.

The samples were analyzed for total organic halogens using EPA Method 9020, adapted for use with soil.

The results of the analyses specified above are presented in Table 1.

The quality assurance information for all sample analyses is reported in Table 2.

Prepared by: Ray Kaminsky, Ph.D.
Project Manager

Approved by: Greg Nicoll
Greg Nicoll
Manager, Inorganic Chemistry

cc: Dean Wolbach

555 Clyde Avenue, P.O. Box 7555, Mountain View, CA 94039 (415) 964-3200 Telex: 34-6391 TWX: 910-7796593

Table 1. Analytical Results of Soil Samples

Acurex No. 8409-033	Sample No.	Total Recoverable Phenolics (μg/g)	Oil and Grease (μg/g)	Lead (μg/g)	Total Organic Halogens (μg/g)
-1	810568	ND	60	7	ND
-2	810569	ND	ND	12	ND
-3	810570	ND	ND	ND	ND
-4	810572	ND	ND	5	ND
-5	810573	1.1	70	21	ND
-6	810574	ND	4,000	19	ND
-7	810575	ND	ND	19	ND
-8	810577	ND	ND	19	ND
-9	810579	ND	ND	11	ND
-10	810580	ND	860	13	ND
-11	810581	ND	ND	19	ND
-12	810583	ND	ND	16	ND
-13	810584	ND	ND	21	1
-14	810586	ND	90	6	ND
-15	810587	ND	ND	5	ND
-16	810590	1.0	ND	8	ND
-17	810491	ND	ND	21	1
-18	810592	0.5	860	53	1
-19	810593	ND	ND	17	ND
-20	810594	ND	ND	20	ND
-21	810595	ND	ND	8	ND
-22	810596	ND	ND	13	ND
-23	810597	ND	ND	9	ND
-24	810598	ND	ND	14	ND
-25	810601	ND	ND	9	ND
-26	810602	ND	ND	10	ND
-27	810605	ND	ND	6	ND
-28	810606	ND	ND	17	2
-29	810607	ND	ND	20	ND
-30	810608	ND	ND	9	1
-31	810611	ND	NS	8	6
-32	810613	ND	14,000	17	1
-33	810614	1.0	29,000	21	1
-34	810615	ND	2,200	24	1
-35	810618	ND	ND	7	ND
-36	810619	ND	ND	5	ND
-37	810621	0.9	1,300	58	2
-38	810622	1.1	1,500	16	1
-39	810623	2.0	9,500	13	1
-40	810627	3.1	6,400	6	1

Table 1. Analytical Results of Soil Samples (Continued)

Acurex No. 8409-033	Sample No.	Total Recoverable Phenolics (µg/g)	Oil and Grease (µg/g)	Lead (µg/g)	Total Organic Halogens (µg/g)
-41	810634	1.4	290	22	2
-42	810635	ND	300	21	1
-43	810637	ND	150	17	1
-44	810638	ND	920	16	ND
-45	810640	ND	ND	19	ND
-46	810642	ND	ND	18	ND
-47	810643	ND	ND	12	ND
-48	810644	ND	50	10	ND
-49	810645	ND	ND	14	ND
-50	810647	ND	ND	17	ND
-51	810648	ND	ND	12	ND
-52	810649	ND	ND	6	ND
-53	810652	ND	ND	8	ND
-54	810653	ND	ND	21	ND
-55	810655	1.4	12,000	22	2
-56	810656	ND	ND	20	ND
-57	810658	ND	ND	7	ND
-58	810659	0.5	140	18	ND
-59	810661	3.0	16,000	17	1
-60	810662	1.2	16,000	4	1
-61	810663	ND	14,000	12	ND
-62	810664	0.5	18,000	12	1
-63	810667	ND	5,500	8	ND
-64	810668	ND	7,600	5	1
-65	810669	ND	ND	18	ND
-66	810670	ND	ND	9	ND
-67	810671	ND	ND	20	1
-68	810672	ND	ND	11	ND
-69	810673	ND	ND	8	ND
-70	810677	ND	80	5	1
-71	810678	ND	ND	13	ND
-72	810679	ND	ND	8	1
-73	810680	ND	ND	9	ND
-74	810683	ND	ND	11	ND
-75	810684	ND	ND	11	ND
-76	810685	ND	ND	7	ND
-77	810686	ND	ND	7	ND
Detection Limit (µg/g)		0.5	50	2	1

Table 2. Quality Assurance Data

PHENOLICS

Method blanks (μg/g)

1	<0.5	5	<0.5
2	<0.5	6	<0.5
3	<0.5	7	<0.5
4	<0.5		

Spikes (percent recovery, spiked at 2.0 μg/g)

810584	85	810656	80
810592	85	810670	80
810602	85	810684	90
810644	85		

Duplicates (μg/g)

810572	<0.5, <0.5	810644	<0.5, <0.5
810574	<0.5, <0.5	810671	<0.5, <0.5
810608	<0.5, <0.5	810672	<0.5, <0.5
810619	<0.5, <0.5		

OIL AND GREASE

Method blanks (μg/g)

1	<50	4	<50
2	<50	5	<50
3	<50		

Spikes (percent recovery, spiked at 95 μg/g)

810597	101	810671	99
810644	101	810679	102
810648	96	810685	98

Duplicates (μg/g)

810570	<50, <50	810615	2200, 2000
810584	<50, <50	810619	<50, <50
810608	<50, <50	810621	1300, 1400

Table 2. Quality Control Data
(Continued)

LEAD

Method Blanks (µg/g)

1	<2	3	<2
2	<2	4	<2

Spikes (percent recovery)

1[a]	102	3[b]	85
2[a]	92	4[b]	85

[a] Spike concentration = 200 ug/g
[b] Spike concentration = 20 ug/g

Duplicates (µg/g)

810569	12, 11	810661	17, 13
810575	20, 19	810672	11, 13

TOTAL ORGANIC HALOGENS

Method Blank

1	<1

Spikes (percent recovery)

810573[c]	88	810575[e]	115
810574[d]	102	810577[f]	125

[c] Spike concentration = 5.0 µg/g
[d] Spike concentration = 5.8 µg/g
[e] Spike concentration = 6.1 µg/g
[f] Spike concentration = 5.7 µg/g

Duplicates (µg/g)

810568	<1	810570	<1
810569	<1	810572	<1

CERTIFIED ANALYTICAL REPORT

November 19, 1984

For

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
Monrovia, CA 91016

By

Acurex Corporation
555 Clyde Avenue
Mountain View, CA 94039

ACUREX
Corporation

ACUREX Corporation

Energy & Environmental Division

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
Monrovia, CA 91016

November 19, 1984
Acurex ID#: 3410-009
Client PO#: 306600.82

Subject: The analysis of 19 Soil Samples from Williams Air Force Base for Total Recoverable Phenols, Oil and Grease, Lead, Cadmium, Chromium and Total Organic Halogens. Samples Received 10/10/84.

The 19 soil samples were analyzed for total recoverable phenolic compounds using EPA Method 420.1, adapted for use with soil. Twenty grams of soil were distilled with 400 mL dionized water and then analyzed as specified by the method.

The samples were analyzed for oil and grease using EPA Method 413.2, adapted for use with soil. Twenty grams of soil were extracted and then analyzed as specified by the method.

The samples were analyzed for lead, cadmium and chromium using EPA Methods 239, 213 and 218, respectively, adapted for use with soil. Five grams of soil were digested in nitric acid and then analyzed as specified in the methods.

The samples were analyzed for total organic halogens using EPA Method 9020, adapted for use with soil.

The results of the analyses specified above are presented in Table 1.

The quality assurance information for all sample analyses is reported in Table 2.

Prepared by: Ray Kaminsky, Ph.D.
Project Manager

Approved by: Greg Nicoll
Manager, Inorganic Chemistry

cc: Dean Wolbach

Table 1. Analytical Results of Soil Samples

Acurex No. 8410-009	Sample No.	Total Recoverable Phenolics (µg/g)	Oil and Grease (µg/g)	Lead (µg/g)	Chromium (µg/g)	Cadmium (µg/g)	Total Organic Halogens (µg/g)
-1	810843	ND	ND	13	17	ND	ND
-2	810844	ND	ND	12	16	ND	ND
-3	811064	ND	ND	11	12	ND	ND
-4	811068	ND	ND	12	22	ND	ND
-5	811070	ND	ND	10	14	ND	ND
-6	811071	ND	ND	10	16	ND	ND
-7	811072	ND	ND	8	25	ND	ND
-8	811073	ND	ND	10	15	ND	ND
-9	811079	ND	ND	8	5	ND	ND
-10	811186	ND	ND	13	18	ND	ND
-11	811189	ND	ND	12	20	ND	ND
-12	811191	ND	ND	7	7	ND	ND
-13	811195	ND	ND	5	11	ND	ND
-14	811376	ND	ND	9	14	ND	ND
-15	811380	ND	ND	14	21	ND	ND
-16	811381	ND	ND	16	16	ND	ND
-17	811634	ND	ND	13	16	ND	ND
-18	811637	ND	ND	19	9	ND	ND
-19	811639	ND	ND	7	20	ND	ND
Detection Limit (µg/g)		0.5	50	2	5	0.2	1

Table 2. Quality Assurance Data

PHENOLICS

Method blanks (μg/g)

1	<0.5	2	<0.5

Spikes (percent recovery, spiked at 2.0 μg/g)

811186	60	811189	65

Duplicates (μg/g)

811079	<0.5, <0.5	811189	<0.5, <0.5

OIL AND GREASE

Method blanks (μg/g)

1	<50	2	<50

Spikes (percent recovery, spiked at 95 μg/g)

811191	102	811637	103

Duplicates (μg/g)

811191	<50, <50	811637	<50, <50

Table 2. Quality Control Data
(Continued)

LEAD

Method Blank (µg/g)

1	<1

Spike (percent recovery, spiked at 20 µg/g)

810844	100

Duplicate (µg/g)

810843	13, 12

CHROMIUM

Method Blank (µg/g)

1	<5

Spike (percent recovery, spiked at 50 µg/g)

810844	110

Duplicate (µg/g)

810843	17, 20

Table 2. Quality Control Data
(Continued)

CADMIUM

Method Blank (μg/g)

1	<0.2

Spike (percent recovery, spiked at 2.0 μg/g)

810844	110

Duplicate (μg/g)

810843	<0.2, <0.2

TOTAL ORGANIC HALOGENS

Method Blank

1	<1

Spike (percent recovery, spiked at 6 μg/g)

810844	94

Duplicate (μg/g)

810843	<1, <1

CERTIFIED ANALYTICAL REPORT

December 3, 1984

For

Mr. Douglas Taylor

AeroVironment, Inc.

825 Myrtle Avenue

Monrovia, CA 91016

By

Acurex Corporation

555 Clyde Avenue

Mountain View, CA 94039

ACUREX Corporation

ACUREX Corporation

Energy & Environmental Division

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
Monrovia, CA 91016

December 3, 1984
Acurex ID#: 8411-001
Client PO#: 306600.82

Subject: The analysis of 11 Soil Samples from Williams Air Force Base for Total Recoverable Phenols, Oil and Grease, Lead, and Total Organic Halogens. Samples Received 9/27/84.

Five of the soil samples were analyzed for total recoverable phenolic compounds using EPA Method 420.1, adapted for use with soil. Twenty grams of soil were distilled with 400 mL dionized water and then analyzed as specified by the method.

Nine of the samples were analyzed for oil and grease using EPA Method 413.2, adapted for use with soil. Twenty grams of soil were extracted and then analyzed as specified by the method.

Two of the samples were analyzed for lead using EPA Method 239 adapted for use with soil. Five grams of soil were digested in nitric acid and then analyzed as specified in the methods.

Five of the samples were analyzed for total organic halogens using EPA Method 9020, adapted for use with soil.

The results of the analyses specified above are presented in Table 1.

The quality assurance information for all sample analyses is reported in Table 2.

Prepared by: Ray Kaminsky
Ray Kaminsky, Ph.D.
Project Manager

Approved by: Greg Nicoll
Greg Nicoll
Manager, Inorganic Chemistry

cc: Dean Wolbach

These results were obtained using accepted laboratory practices; the liability of Acurex Corporation shall not exceed the amount paid for this report. In no event shall Acurex be liable for special or consequential damages.

Table 1. Analytical Results of Soil Samples

Acurex No. 8411-001	Sample No.	Total Recoverable Phenolics (µg/g)	Oil and Grease (µg/g)	Lead (µg/g)	Total Organic Halogens (µg/g)
-1	810616	ND	ND	11	ND
-2	810624	2.3	6,600	--	1
-3	810626	3.4	4,900	--	--
-4	810628	2.2	6,700	--	--
-5	810631	--	9,500	--	--
-6	810636	--	ND	--	--
-7	810654	--	--	10	--
-8	810660	0.8	13,000	--	ND
-9	810665	--	14,000	--	1
-10	810666	--	7,000	--	--
-11	810610	--	--	--	ND
Detection Limit (µg/g)		0.5	50	2	1

Table 2. Quality Assurance Data

PHENOLICS

Method blank (µg/g)

1	<0.5

Spike (percent recovery, spiked at 2.0 µg/g)

811092	80

Duplicate (µg/g)

811086	1.0, 1.1

OIL AND GREASE

Method blank (µg/g)

1	<50

Spike (percent recovery, spiked at 95 µg/g)

810616	101

Duplicate (µg/g)

810616	<50, <50

Table 2. Quality Control Data
(Continued)

LEAD*

Method Blank (μg/g)

1	<2	2	<2

Spikes (percent recovery)

811175	110[a]	812168	95[a]
811175	112[b]		

[a] Spiked at 20 μg/g
[b] Spiked at 50 μg/g

Duplicate (μg/g)

810702	13, 17

* These samples were analyzed along with those from the 8410-007 set, thus those QA data are presented.

TOTAL ORGANIC HALOGENS

Method Blank

1	<1

Duplicate (μg/g)

810616	<1, <1

CERTIFIED ANALYTICAL REPORT

December 14, 1984

For

Mr. Douglas Taylor
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825 Myrtle Avenue
Monrovia, CA 91016

By

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555 Clyde Avenue
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Mr. Douglas Taylor
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825 Myrtle Avenue
Monrovia, CA 91016

December 14, 1984
Acurex ID#: 8410-017
Page 1 of 2

Subject: The analysis of Four Drum Samples from Williams Air Force Base for Ignitability and EP Toxicity Metals; Samples Received 10/16/84

The Extraction Procedure Toxicity Test was carred out on the above samples following Test Methods for Evaluating Solid Waste (SW-846). One hundred grams of each sample was extracted in 1600 mL of deionized water plus 0.5N acetic acid to a pH of 5.0 for 24 hours. The final volume was adjusted to 2000 mL. The samples were digested with nitric acid and analyzed by atomic absorption spectrophotometry for eight metals. Samples were also subjected to Ignitability Test from the same protocol using a closed-cup method.

Results are presented in Table 1. Drum #3 and #4 had a lead content in the extract above the EP Toxicity limit. None of the samples were determined to be ignitable at 650°C.

Prepared by: Patrick M. Hink for
Ray Kaminsky, Ph.D.
Project Manager

Approved by: Greg Nicoll
Greg Nicoll
Manager, Inorganic Chemistry

RK/GN/ats

cc: Dean Wolbach

These results were obtained using accepted laboratory practices; the liability of Acurex Corporation shall not exceed the amount paid for this report. In no event shall Acurex be liable for special or consequential damages.

Table 1. EP Toxicity, mg/L

Sample ID	811102 Drum #3	811105 Drum #4	811106 Drum #1	811109 Drum #2	Laboratory Blank
Arsenic	<0.01	<0.01	<0.01	<0.01	<0.01
Barium	0.9	0.7	0.7	0.9	<0.2
Cadmium	<0.01	<0.01	<0.01	<0.01	<0.01
Chromium	<0.05	<0.05	<0.05	<0.05	<0.05
Lead	10[1]	12[1]	0.23	<0.02	<0.02
Mercury	<0.001	<0.001	<0.001	<0.001	<0.001
Selenium	<0.01	<0.01	<0.01	<0.01	<0.01
Silver	<0.01	<0.01	<0.01	<0.01	<0.01
Ignitability, °C[2]	>65°	>65°	>65°	>65°	--

1 EP Toxicity limit is 5.0 mg/L

2 Performed on drum contents

CERTIFIED ANALYTICAL REPORT

December 11, 1984

For

Mr. Douglas Taylor

AeroVironment, Inc.

825 Myrtle Avenue

Monrovia, CA 91016

By

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ACUREX Corporation

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Mr. Douglas Taylor
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Monrovia, CA 91016

December 11, 1984
Acurex ID#: 8411-039

Subject: The analysis of 13 Soil Samples from Williams Air Force Base for Lead and Chromium. Samples Received 11/21/84.

Samples were analyzed for lead and chromium using EPA Method 239 and 218 adapted for use with soil. Five grams of soil were digested in nitric acid and then analyzed as specified in the methods.

The results of the analyses specified above are presented in Table 1.

The quality assurance information for all sample analyses is reported in Table 2.

Prepared by: Ray Kaminsky, Ph.D.
Project Manager

Approved by: Greg Nicoll
Manager, Inorganic Chemistry

cc: Dean Wolbach

These results were obtained using accepted laboratory practices; the liability of Acurex Corporation shall not exceed the amount paid for this report. In no event shall Acurex be liable for special or consequential damages.

Table 1. Analytical Results of Soil Samples

Acurex No. 8411-039	Sample No.	Lead (µg/g)	Chromium (µg/g)
-1	810842	16	6
-2	810845	7	--
-3	810846	8	--
-4	811065	11	16
-5	811066	10	9
-6	811074	--	12
-7	811075	--	7
-8	811188	10	8
-9	811377	8	7
-10	811378	9	13
-11	811635	7	--
-12	811636	--	10
-13	811638	--	11
Detection Limit (µg/g)		2	5

Table 2. Quality Assurance Data

	Lead	Chromium
Method blank (μg/g)		
	<2	<5
Spike (percent recovery)		
810842	94	99
Spiked at 100 μg/g		
Duplicate (μg/g)		
810842	16, 11	6, 12

CERTIFIED ANALYTICAL REPORT

December 17, 1984

For

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
Monrovia, CA 91016

By
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555 Clyde Avenue
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ACUREX Corporation

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Energy & Environmental Division

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
Monrovia, CA 91016

December 17, 1984
Acurex ID#: 8411-038

Subject: The analysis of Two Soil Samples from Williams Air Force Base for Oil and Grease and Lead; Samples Received 9/27/84.

Both samples were analyzed for oil and grease using EPA Method 413.2, adapted for use with soil. Twenty grams of soil were extracted and then analyzed as specified by the method.

Both samples were analyzed for lead using EPA Method 239 adapted for use with soil. Five grams of soil were digested in nitric acid and then analyzed as specified in the methods.

The results of the analyses specified above are presented in Table 1.

The quality assurance information for all sample analyses is reported in Table 2.

Prepared by: Ray Kaminsky, Ph.D.
Project Manager

Approved by: Greg Nicoll
Manager, Inorganic Chemistry

cc: Dean Wolbach

These results were obtained using accepted laboratory practices; the liability of Acurex Corporation shall not exceed the amount paid for this report. In no event shall Acurex be liable for special or consequential damages.

Table 1. Analytical Results of Soil Samples

Acurex No. 8411-038	Sample No.	Oil and Grease (µg/g)	Lead (µg/g)
-1	810625	8,500	13
-2	810629	10,000	8
Detection Limit (µg/g)		50	2

Table 2. Quality Assurance Data

OIL AND GREASE

Method blank (μg/g)

1	<50

Duplicate (μg/g)

810625	8,500; 9,600

LEAD

Method Blank (μg/g)

<2

Spike (percent recovery)

810629	99[a]

[a] Spiked at 100 μg/g

Duplicate (μg/g)

810629	8, 6

CERTIFIED ANALYTICAL REPORT

January 3, 1985

For

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
Monrovia, CA 91016

By

Acurex Corporation
555 Clyde Avenue
Mountain View, CA 94039

ACUREX Corporation

ACUREX Corporation

Energy & Environmental Division

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
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January 3, 1985
Acurex ID#: 8411-026
Client PO#: 306600.82

Subject: The analysis of 14 Soil Samples from Williams Air Force Base for Total Recoverable Phenols, Oil and Grease, Lead, and Total Organic Halogens. Samples Received 11/13/84.

Nine of the soil samples were analyzed for total recoverable phenolic compounds using EPA Method 420.1, adapted for use with soil. Twenty grams of soil were distilled with 400 mL deionized water and then analyzed as specified by the method.

Ten of the samples were analyzed for oil and grease using EPA Method 413.2, adapted for use with soil. Twenty grams of soil were extracted and then analyzed as specified by the method.

Twelve, eight and six of the samples were analyzed for lead, cadmium and chromium using EPA Method 239, 203, and 218 respectively, adapted for use with soil. Five grams of soil were digested in nitric acid and tnen analyzed as specified in the methods.

Seven of the samples were analyzed for total organic halogens using EPA Method 9020, adapted for use with soil.

The results of the analyses specified above are presented in Table 1.

The quality assurance information for all sample analyses is reported in Table 2.

Prepared by: Ray Kaminsky, Ph.D.
Project Manager

Approved by: Greg Nicoll
Manager, Inorganic Chemistry

cc: Dean Wolbach

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Table 1. Analytical Results of Soil Samples

Sample No.	Total Recoverable Phenolics (μg/g)	Oil and Grease (μg/g)	Lead (μg/g)	Chromium (μg/g)	Cadmium (μg/g)	Total Organic Halogens (μg/g)
810694	ND	ND	12	17	ND	ND
810705	--	--	160	--	--	--
810707	ND	ND	24	--	--	ND
810709	--	--	840	--	--	--
810710	--	130	830	--	--	--
811028	ND	ND	7	--	--	ND
811038	0.6	80	64	--	--	2
811155	ND	ND	9	11	ND	ND
811170	--	--	--	14	--	--
811171	ND	ND	9	14	ND	ND
811172	--	--	--	9	--	--
811184	ND	ND	8	8	ND	ND
811526	ND	ND	16	19	ND	--
811530	ND	ND	10	13	ND	--
Detection Limit (μg/g)	0.5	50	2	5	0.2	1

Table 2. Quality Assurance Data

PHENOLICS

Method blank (µg/g)

1	<0.5

Spike (percent recovery, spiked at 2.0 µg/g)

811526	80

Duplicate (µg/g)

811526	0.5, <0.5

OIL AND GREASE

Method blank (µg/g)

1	<50

Spike (percent recovery, spiked at 95 µg/g)

811526	81

Duplicate (µg/g)

810694	<50, <50

LEAD

Method Blank (µg/g)

1	<2

Spikes (percent recovery, spiked at 100 µg/g)

810694	104

Duplicate (µg/g)

810694	12, 11

Table 2. Quality Control Data
(Continued)

CHROMIUM

Method blank (μg/g)

1	<5

Spike (percent recovery, spiked at 100 μg/g)

810694	105

Duplicate (μg/g)

810694	17,	9

CADMIUM

Method blank (μg/g)

1	<0.2

Spike (percent recovery, spiked at 40 μg/g)

810694	99

Duplicate (μg/g)

810694	<0.2,	<0.2

TOTAL ORGANIC HALOGENS

Method Blank (μg/g)

1	<1

Duplicate (μg/g)

810694	<1,	<1

CERTIFIED ANALYTICAL REPORT

February 27, 1985

For

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
Monrovia, CA 91016

By

Acurex Corporation
555 Clyde Avenue
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ACUREX Corporation

ACUREX Corporation

Energy & Environmental Division

Mr. Douglas Taylor
AeroVironment, Inc.
825 Myrtle Avenue
Monrovia, CA 91016

February 27, 1985
Acurex ID#: 8410-0128
Client PO#: 306600.82
Page 1 of 6

Subject: The Analysis of 26 Soil Samples from Williams Air Force Base for Total Recoverable Phenols, Oil and Grease, Lead, Chromium, Cadmium, Copper, Cyanide, Total Organic Halogens, and Methylethyl Ketone. Samples Received 9/27/84.

Twenty-six of the soil samples were analyzed for total recoverable phenolic compounds using EPA Method 420.1, adapted for use with soil. Twenty grams of soil were distilled with 400 mL deionized water and then analyzed as specified by the method.

Twenty-six of the samples were analyzed for oil and grease using EPA Method 413.2, adapted for use with soil. Twenty grams of soil were extracted and then analyzed as specified by the method.

Twenty-six of the samples were analyzed for lead using EPA Method 239 adapted for use with soil. Five grams of soil were digested in nitric acid and then analyzed as specified in the methods.

Fourteen of the samples were analyzed for chromium, cadmium, copper and cyanide using EPA Methods 218.1, 213.2, 220.1 and standard method 412 respectively, all modified for use with soil.

Twenty-six of the samples were analyzed for total organic halogens using EPA Method 9020, adapted for use with soil.

Twenty-two samples were analyzed for methylethyl ketone. Five of the samples were analyzed using purge and trap, gas chromatography photoionization detection (EPA Method 503.1). Eighteen of the samples were analayzed by purge and trap, gas chromatography mass spectrometry (EPA Method 624).

The results of the analyses specified above are presented in Table 1.

The quality assurance information for all sample analyses is reported in Table 2.

Prepared by: [signature] for
Ray Kaminsky, Ph.D.
Project Manager

Approved by: [signature]
Greg Nicoll
Manager, Inorganic Chemistry

RK/GN/ats

cc: Dean Wolbach

These results were obtained using accepted laboratory practices; the liability of Acurex Corporation shall not exceed the amount paid for this report. In no event shall Acurex be liable for special or consequential damages.

Table 1. Analytical Results of Soil Samples

Sample No.	Total Recoverable Phenolics (µg/g)	Oil and Grease (µg/g)	Lead (µg/g)	Chromium (µg/g)	Cadmium (µg/g)	Copper (µg/g)	Cyanide (µg/g)	Total Organic Halogens (µg/g)	Methylethyl Ketone* (µg/g)
811090	2.2	90	34	--	--	--	--	ND	--
811093	ND	ND	25	--	--	--	--	ND	--
811094	3.4	41,000	38	--	--	--	--	1	--
811097	ND	1,100	23	--	--	--	--	ND	--
811095	ND	110	40	--	--	--	--	1	0.016
811096	ND	260	72	--	--	--	--	1	ND
811098	ND	ND	10	--	--	--	--	ND	ND
811099	0.7	60	29	--	--	--	--	ND	ND
811100	ND	320	67	--	--	--	--	1	ND
811101	1.6	180	38	--	--	--	--	1	ND
811103	ND	ND	15	--	--	--	--	ND	ND
811104	ND	ND	21	--	--	--	--	ND	ND
811077	ND	11,000	680	190	44	130	ND	10	0.028
811078	ND	100	96	45	4.0	38	ND	7	ND
811080	ND	130	24	27	3.0	17	ND	1	ND
811081	ND	ND	28	25	1.0	18	ND	ND	ND
811082	1.9	100,000	1,500	470	90	180	ND	14	ND
811083	ND	170	70	40	4.0	33	ND	2	0.006
811084	ND	ND	21	26	ND	16	ND	ND	ND
811085	3.6	13,000	100	53	8.2	33	ND	4	ND
811086	1.1	100	88	360	1.6	34	ND	1	ND
811087	ND	ND	42	23	0.6	32	ND	1	ND
811088	ND	ND	27	20	ND	30	ND	ND	ND
811089	ND	ND	34	20	ND	34	ND	ND	ND
811091	ND	ND	22	18	ND	15	ND	ND	ND
811092	ND	ND	29	24	ND	26	ND	ND	ND
Detection Limit (µg/g)	0.5	50	2	5	0.2	0.4	2	1	0.005

ND - Not detected

* Samples No. 811095 to 811100 were analyzed using GC/PID (detection limit of 0.001 µg/g).
Samples No. 811100 to 811092 were analyzed using GC/MS (sample 811100 analyzed by both methods).

Table 2. Quality Assurance Data

PHENOLICS

Method blank (μg/g)

1	<0.5
2	<0.5

Spike (percent recovery, spiked at 2.0 μg/g)

811092	88
811086	76

Duplicates (μg/g)

811082	1.9, 2.1
811091	<0.5, <0.5

OIL AND GREASE

Method blanks (μg/g)

1	<50
2	<50

Spikes (percent recovery, spiked at 95 μg/g)

811080	105
811088	90

Duplicates (μg/g)

811081	<50, <50
811092	<50, <50

Table 2. Quality Assurance Data
(Continued)

LEAD

Method Blank (μg/g)

1	<2

Spikes (percent recovery)

811097	99
811081	87

Duplicates (μg/g)

811080	30, 24
811094	38, 38

CHROMIUM

Method blank (μg/g)

1	<5

Spike (percent recovery, spiked at 40 μg/g)

811081	105

Duplicate (μg/g)

810080	27, 33

Table 2. Quality Assurance Data
(Continued)

CADMIUM

Method blank (μg/g)

1	<0.2

Spike (percent recovery, spiked at 40 μg/g)

811081	91

Duplicate (μg/g)

811080	3.0, 3.8

COPPER

Method blank (μg/g)

1	<0.4

Spike (percent recovery, spiked at 40 μg/g)

811081	81

Duplicate (ug/g)

811080	17, 22

Table 2. Quality Assurance Data
(Continued)

CYANIDE

Method blank (μg/g)

1	<2

Spike (percent recovery, spiked at 200 μg/g)

811092	85

Duplicate (μg/g)

811092	<2,	<2

TOTAL ORGANIC HALOGENS

Method Blank (μg/g)

1	<1
2	<1

Spike (percent recovery, spiked at 4.7 μg/g)

811093	93

Duplicate (μg/g)

811090	<1, <1

METHYLETHYL KETONE

Method Blank (μg/g)

1	<0.001	(GC/PID)
2	<0.005	(GC/MS)

Spike (percent recovery, spiked at 0.106 μg/g)

811086	98

Duplicate (μg/g)

811099	<0.001
811087	<0.005

AD-A167 798 INSTALLATION RESTORATION PROGRAM PHASE II CONFIRMATION/QUANTIFICATION STA..(U) AEROVIRONMENT INC MONROVIA CA 24 JAN 86 F33615-83-D-4000 TR-85-86 4/4

UNCLASSIFIED F/G 13/2 NL

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DATE
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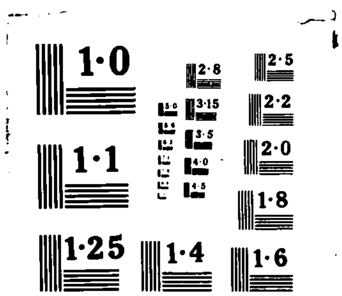
6 86


1.0
2.8
2.5
3.15
2.2
3.5
2.0
1.1
4.0
4.5
1.8
1.25
1.4
1.6

APPENDIX H

References

H. REFERENCES

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Telephone communication with on-base personnel: Capt. Ruel Burns, Base Bio-environmental Engineer; Chief Larry Cole, Base Fire Chief; Mr. Petross, Liquid Fuels Manager; and Mr. Meyers, Civil Engineering.

Telephone communication with other government agencies: Arizona Department of Water Resources and U.S. Geological Survey, Water Resources Division, Phoenix.

APPENDIX I

Biographies of Key Personnel

RESUME

David Bush
Associate Quality Assurance Engineer
AeroVironment Inc.

Education

B.S., Atmospheric Science, University of California at Davis, 1980
EPA Training Program, U.C. Davis, 1979-80
EPA Air Pollution Training Institute course, Quality Assurance for Air Pollution Measurement Systems, 1980

Professional Experience

Mr. Bush assists in administering the quality assurance program on AeroVironment's air quality, meteorology, and low-level radioactivity measurement programs, as well as in quality assurance services provided for other clients. In this role, he performs instrument calibrations, performance audits, data validation, and statistical analysis of data quality. He supervised the quality assurance program for a large visibility monitoring program AV performed for the Electric Power Research Institute. As part of that effort, he recently participated in a study focusing on intercomparison of teleradiometer performance.

In previous work for AeroVironment, he was a Field Technician, responsible for routine station checks and participating in special field experiments. As one example, he launched RD-65 radiosondes during a 90-day monitoring program for a utility in northern California. In addition, he flew aboard AV's instrumented air monitoring aircraft as instrument technician for 25 flights in a recent EPA-sponsored study of persistent elevated pollution episodes (PEPEs).

At the University of California at Davis, he worked as a Meteorology Technician, performing maintenance and repair of meteorology instruments.

RESUME

Timothy F. O'Gara
Hydrogeologist
Field Operations

Education

B.A., Earth Science, California State University, Fullerton, 1980

Technical Specialties

Hazardous Waste Investigations
Ground Water Monitoring
Water Supply Well Design and Inspection

Professional Experience

Mr. O'Gara is a hydrogeologist in the Environmental Programs Division at AeroVironment. In this capacity, he provides key support to AV's hazardous waste projects. He is presently involved in a soil contamination study under an Installation Restoration Program assignment for the U.S. Air Force. For this field program, he prepared soil sampling procedures and was responsible for field-logging of soil samples. He is also responsible for writing report sections on environmental setting, field activities, and site-specific geology and hydrogeology. Mr. O'Gara also provides coordination with drilling and geophysical subcontractors.

Mr. O'Gara was self employed as a Contracting Hydrogeologist before joining AV. During his self employment he worked with several consulting firms in Southern California, providing specialized hydrology and geology consulting. He directed drilling and soil sampling programs for numerous leaking underground storage tank investigations at facilities in the Los Angeles area. These programs were conducted in accordance with the guidelines adopted by the California Regional Water Quality Control Board. His responsibilities included insuring that proper safety, sampling protocol, and chain of custody procedures were followed throughout the investigation. He was also responsible for selection of test boring sites. During other consulting work, he provided design and on-site inspection services for

groundwater projects as diverse as municipal water supply wells and multiple completion piezometer networks.

Mr. O'Gara was previously employed by James M. Montgomery Consulting Engineers (JMM). While with JMM, he served as the Resident Geologist at the initial closure of Stringfellow Quarry Class I hazardous waste site. In that capacity, he supervised the placement of the subsurface containment barrier, installation of down gradient monitoring wells and monitored groundwater conditions during the construction. Additional significant assignments included field inspection for extension of the Alamitos Injection Well Salinity Barrier for Orange County Water District, installation of various piezometer networks, and performance of isolated zone tests in deep wells. The latter project helped to determine the water quality of specific aquifers within multiple aquifer systems.

Professional Memberships

National Water Well Association

RESUME

Douglas B. Taylor, P.E.
Project Manager, Hazardous Waste
Environmental Programs Division

Education

M. Engr., Environmental Engineering, The Pennsylvania State University, 1980

B.S., Environmental Engineering, The Pennsylvania State University, 1979

Technical Specialties

Hazardous Waste Management
Water Supply Treatment
Wastewater Treatment

Professional Experience

Mr. Taylor serves as a key project manager in the Hazardous Waste Program for AeroVironment. In this capacity he is responsible for field activities, project planning, engineering input, schedule and budget control and team management. Mr. Taylor manages a level of effort Air Force contract related to the Installation Restoration Program for assessment and investigation of hazardous waste at bases throughout the country. He is presently working on an extensive investigation of potential soil contamination of several locations. The problems result from leaking tanks and poor waste management. Mr. Taylor also serves as Corporate Health and Safety Officer.

Mr. Taylor previously worked for Ecology and Environment Inc. as the Group Leader for Preliminary Assessments and Site Inspections on EPA's Field Investigation Team contract in Denver, Colorado. As Group Leader, he managed routine assignments including site inspections, sampling projects and impact assessments at over 50 sites in EPA Regions 3 and 8. The types of sites he has worked on include landfills, mining facilities, active refineries, and abandoned hazardous waste dumps. Mr. Taylor has prepared several engineering reports for EPA sites. He prepared a remedial investigation plan for the McAdoo Drum site in Pennsylvania, a cost estimate report for slag isolation in Philadelphia, and a delisting analysis for a National Priority List site in Utah. Additional specialized work included managing several geotechnical/hydrological drilling projects and drum opening activities.

Mr. Taylor has also worked for D'Appolonia Consultants and was involved in a variety of water quality and hazardous waste related projects. He worked extensively as the principal engineer in the investigation of a toxic waste impoundment at the Rocky Mountain Arsenal in Denver. He was also involved in a support capacity with the work effort for the Strategic Petroleum Reserve, providing water quality studies and investigation of treatment alternatives for raw water used in the expansion of salt caverns. In addition, he has worked on a non-hazardous landfill design including preparation of a permit application.

Registration

Professional Engineer, Colorado, No. 21003; California, No. 37816

Professional Memberships

American Society of Civil Engineers, Hazardous Waste Committee of the Environmental Engineering Division
American Water Works Association
Chi Epsilon
Water Pollution Control Federation

APPENDIX J

Geophysical Tracings

	0	10	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
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L+5																			
L	X366	X411	X420		X316		X333		X319		X313		X321		X343		X340		X34[illegible]
K+5																			
K	X379	X472	X1190	X662	X236	X372	X449	X451	X491	X396	X262	X265	X313	X334	X341	X341	X342	X346	[illegible]
J+5	X367	X417	X579	X380	X288	X427	X524	X519	X620	X502	X241	X263	X30[illegible]	X408	X355	X355	X355	X355	X34[illegible]
J	X367	X367	X395	X337	X335	X416	X451	X425	X512	X430	X247	X270	X3[illegible]	X379	X349	X300	X343	X347	[illegible]
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C+5	X345	X347	X351	X341	X242	X143	X163	X247	X297	X225	X284	X311	X359	X368	X364	X327	[illegible]	X315	[illegible]
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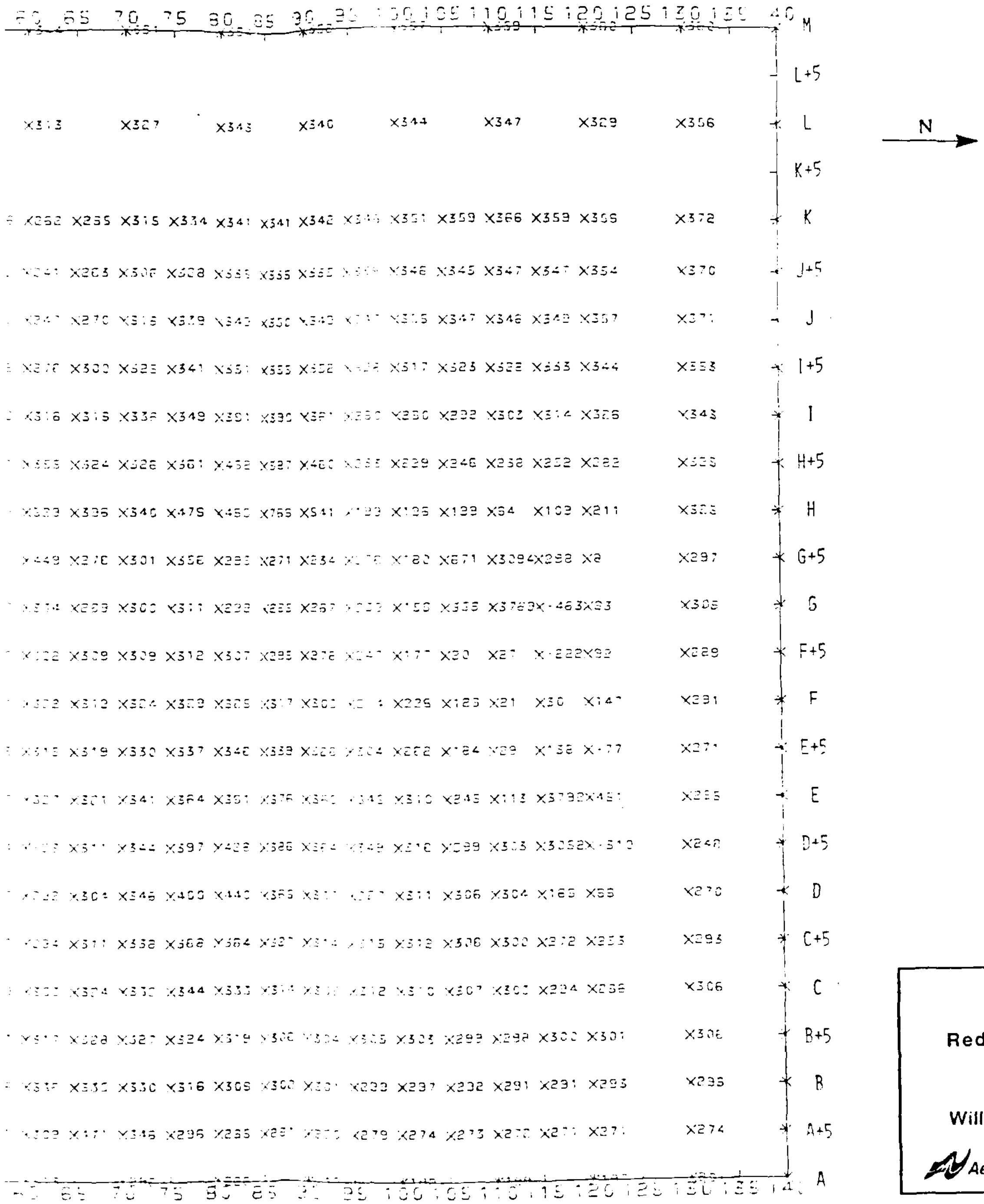

Figure J-1

Reduced Magnetic Data

9/22/84

Williams Air Force Base

AeroVironment Inc. MONROVIA CA

December 1984

10/11/94 MAGNETIC SURVEY - WILLIAMS AFB   GAMMAS + 50.000

PLOT NO. 1   DATE 10:30:91   TIME 12:10:34

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L	X363	X374	X401	X446	X462	X379	X319	X333	X333	X321	X317	X313	X313	X319	X329	X330	X343	X343	X343	X345	X346	X3
K+5	X365	X355	X439	X593	X796	X522	X302	X330	X357	X335	X334	X310	X295	X307	X322	X311	X339	X339	X339	X342	X347	X3
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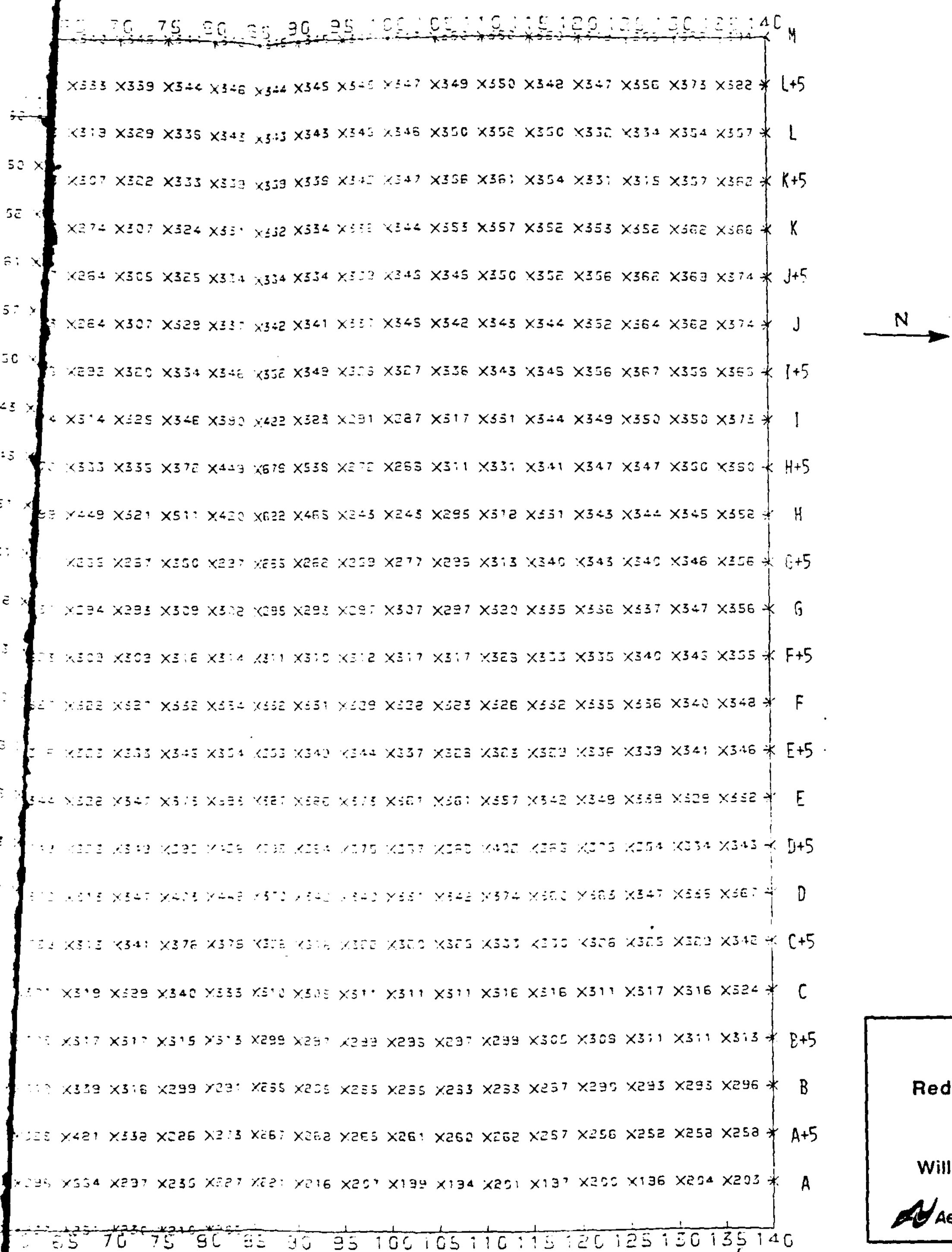


Figure J-2
Reduced Magnetic Data
10/11/84

Williams Air Force Base

AeroVironment Inc. MONROVIA, CA

December 1984

APPENDIX K

Safety Plan

AEROVIRONMENT INC.

Hazardous Waste Project Site Safety Plan

Name of Site WILLIAMS AIR FORCE BASE

Address of Site 30 MILES S.E. OF PHOENIX AZ

Client U.S. AIR FORCE Project No. 10416E

Client's Site Contact CAPT RUEL BURNS

Plan Prepared By DOUG TAYLOR Date 8/17/84

Plan Reviewed By (AV) DOUG TAYLOR DST Date 8/17/84

Plan Approved By (Med-Tox) Dan R Thorne Ph.D. Date 9/10/84

Overall Objective of Site Visit COLLECT SOIL SAMPLES AT SIX LOCATIONS AND CONDUCT GEOPHYSICAL WORK AT ONE: TO ASSESS POTENTIAL CONTAMINATION FROM WASTE DISPOSAL

Proposed Date(s) of Site Visit SEPT 24 17, 1984 UNTIL COMPLETION (~ 3 WEEKS ON SITE)

Source of Information on the Site U.S.A.F.

How Old is Information? PRESENT DAY TO ~ 20 YEARS

Overall Hazard Estimation ____ High ____ Medium ✓ Low

NO WORK IS ANTICIPATED TO BE DONE W/ RESPIRATORY PROTECTION

Physical Description of the Facility (attach map) 4127 ACRES IN THE DESERT S.E OF PHOENIX. THE SITE IS VERY FLAT AND DRY. SITE INCLUDES AIRFIELD, HOUSING AREA, OFFICES, SHOPS AND OPEN AREAS

Operational Description of the Facility U.S.A.F. HAS USED WILLIAMS AFB AS A TRAINING FACILITY FOR PILOTS SINCE 1941. GENERAL ACTIVITIES NORMAL TO JET FUELING & CLEANING AND BASE UPKEEP ARE CARRIED OUT

Site Status: ✓ Active ____ Closed ____ Abandoned ____ Unknown

AV-F-HS07a

List the Waste(s) of Concern:

Waste	Physical State	Characteristics
JET FUELS	LIQUID (AT TIME	FLAMABLE
SOLVENTS	" OF DISPOSAL)	"
HEAVY METALS	"	TOXIC
(ELECTROPLATING)		FLAMABLE
WASTE OILS	"	
PESTICIDES	(NO DIGGING IN THE PESTICIDE	BURIAL AREA)

Describe Potential Environmental Hazards POTENTIAL ENVIRONMENTAL HAZARDS ARE PROBABLY LIMITED TO SOIL CONTAMINATION OR SURFACE EXPRESSIONS, GROUNDWATER VERY DEEP

Describe Potential Worker Hazards POTENTIAL EXPOSURE TO VAPORS RELEASED DURING DRILLING. POTENTIAL EXPOSURE TO MATERIALS &/OR SOIL BROUGHT UP OUT OF THE HOLE (DERMAL OR VAPORS).

THE GREATEST RISK IS FROM MECHANICAL INJURY DURING THE DRILLING, PARTICULARLY HAND INJURY.

ACTIVITY CONSIDERATIONS

Will site officials be with you? _____Yes ✓ No

Is exact location of wastes: ✓ Known _____Assumed _____Unknown

Describe proximity of potential offsite, human receptors THERE ARE ON-BASE RESIDENCES AND BASE WORK STATIONS NEAR MOST OF THE SITES. NO OFF-BASE RECEPTORS WITHIN MILES

List Particular Activities Planned:

Activity	Location	Date
DRILLING & SAMPLING	LFSA, FPTA, LANDFILL	SOMETIME IN
PLACING CONCRETE	DRAINAGES (2)	THE 3 WEEK
GEOPHYSICAL SURVEY	PESTICIDE BURIAL	PERIOD

AV-F-HS075

2 LOCATIONS

SAFETY CONSIDERATIONS

If there is more than one level of hazard, or if there are multiple "sites" within a "site," a separate page 3 and 4 should be completed to show specific safety considerations for each location.

Work Locations FIRE PROTECTION TRAINING AREA & LANDFILL

Objective of Work at This Location • DRILL 12 10' HOLES AND COLLECT SOIL SAMPLES AT FPTA
• DRILL 7 100' HOLES AND COLLECT SOIL SAMPLES AT LANDFILL

Level of Protection Planned: ____ A ____ B ____ C _✓_ D

Possible Modifications UPGRADE AS NECESSARY

Surveillance Equipment:

✓ OVA (CONTINUOUS) ✓ O_2

✓ Explosimeter

Body Coverings to be Used:

Type of Boots: STEEL TOE LEATHER

Type of Gloves: SURGEONS & BUTYL RUBBER

Type of Face Protection: SAFETY GLASSES

Type of Coveralls: COTTON (UPGRADE TO CHEMCLOS OR TYVEX IF "MESSY")

Additional Gear: LEATHER GLOVES FOR DRILLERS

Work Party:

Name	Responsibility	Level of Protection
DOUG TAYLOR	SAFETY	D*
TIM O'GARA	SAMPLE COLLECTION	D
DRILLERS (2)	" "	D*

* POSSIBLE UPGRADES

Site Entry Procedures COORDINATE INITIAL ENTRY W/ USAF PERSONNEL, CHECK IN & OUT AT MAIN GATE DAILY

Call CAPT BURNS Before Entering, At 988-2611 (Phone No.)

AV-F-HS07c

Criteria for Changing Protection OVM READINGS > 5 PPM ABOVE BACKGROUND WILL BE CAUSE FOR APRs. > 50 PPM WILL BE CAUSE FOR SCBA.* NOTE: BREATHING ZONE MEASUREMENTS.

Decontamination Procedures WASH DRILLING EQUIPMENT WITH HOT HI-PRESSURE WASH. WASH SAMPLING EQUIP AND BOOTS/GLOVES WITH ALKANOX + WATER

Work Limitations (Time of Day, etc.) DAYLIGHT, OTHER HOURS AS SPECIFIED BY USAF

Disposal of Disposable Materials, Drill Spoils, Decontaminated Water, etc.
FIELD DECISION WILL BE MADE BASED ON OVM READINGS + VISUAL CHECKS WHETHER WASTES WILL BE DRUMMED OR PLACED IN HARDFILL (NONHAZARDOUS)

Location of Nearest Phone MOTOR POOL BUILDING OR TREATMENT PLANT

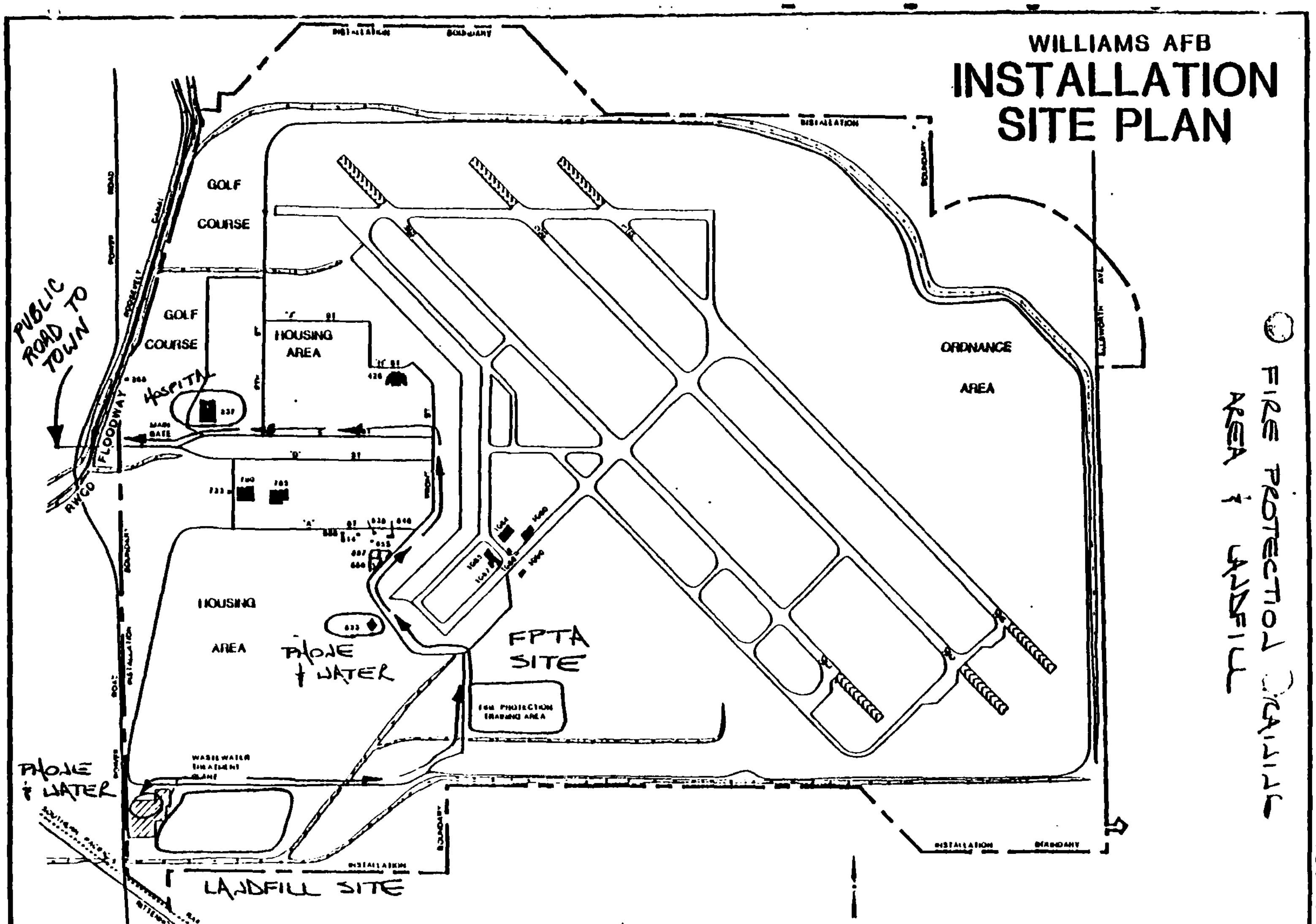
Nearest Water " " " " "

Public Road WILLIAMS FIELD ROAD, RUNS WEST TO I-10

Provide Site Sketch (with all relevant facilities)

SEE ATTACHED MAP

* KEROSENE, THE MAJOR COMPONENT OF JET FUEL, IS NOT DESCRIBED IN NIOSH HANDBOOK. SAX DESCRIBES KEROSENE AS LOW TOXICITY VIA ORAL ROUTE + ONLY INHALATION OF HIGH CONCENTRATION IS BAD. SAX DESCRIBES TOLUENE AS MODERATE VIA INHALATION. 5 + 50 CRITERIA ARE MORE STRINGENT THAN HEXANE, XYLENE TOLUENE + CARBON TET. STANDARDS FROM NIOSH. (TYPICAL SOLVENTS)



SOURCE: WILLIAMS AFB INSTALLATION DOCUMENTS

2 LOCATIONS

SAFETY CONSIDERATIONS

If there is more than one level of hazard, or if there are multiple "sites" within a "site," a separate page 3 and 4 should be completed to show specific safety considerations for each location.

Work Locations SURFACE DRAINAGE SYSTEM NW & SW

Objective of Work at This Location • OBTAIN SURFACE SOIL SAMPLES AND SOIL SAMPLES AT 4' DEPTH ALONG EACH OF THE DRAINAGE CHANNELS (SHALLOW CHANNELS)

Level of Protection Planned: ___ A ___ B ___ C ✓ D

Possible Modifications UPGRADE AS NECESSARY

Surveillance Equipment:

✓ OVA ___ O_2

___ Explosimeter

Body Coverings to be Used:

Type of Boots: STEEL TOE LEATHER OR NEOPRENE

Type of Gloves: LEATHER FOR WORK RUBBER FOR SAMPLING

Type of Face Protection: SAFETY GLASSES

Type of Coveralls: COTTON

Additional Gear: NONE

Work Party:

Name	Responsibility	Level of Protection
DOUG TAYLOR	SAFETY & SAMPLING	D
TIM O'GARA	SAMPLING	D

Site Entry Procedures COORDINATE ENTRY W/ USAF PERSONNEL, CHECK IN AND OUT W/ MAIN GATE

Call CAPT BURNS Before Entering, At 983-2611 (Phone No.)

AV-F-HS07c

Criteria for Changing Protection OVM READINGS > 5 PPM ABOVE BACKGROUND WILL BE CAUSE FOR APR. > 50 PPM ABOVE BACKGROUND WILL REQUIRE SCBA * (BREATHING ZONE)

Decontamination Procedures WASH SAMPLER AND AUGER WITH ALKANOX AND WATER AND RINSE SAMPLER WITH DISTILLED WATER. BOOTS & GLOVES WASH W/ ALKANOX & WATER

Work Limitations (Time of Day, etc.) DAYLIGHT. THESE SITES ARE NEAR ON-BASE HOUSING, MUST MAKE SURE TO KEEP RESIDENTS AWAY FROM WORK AREAS

Disposal of Disposable Materials, Drill Spoils, Decontaminated Water, etc.
FIELD DECISION WILL BE MADE BASED ON OVM READINGS AND VISUAL CHECKS, WHETHER WASTES WILL BE DRUMMED OR PLACED IN HARDFILL AREAS (FOR NONHZ MATLS)

Location of Nearest Phone SW - MOTOR POOL, NW - HOSPITAL

Nearest Water HOUSING AREAS

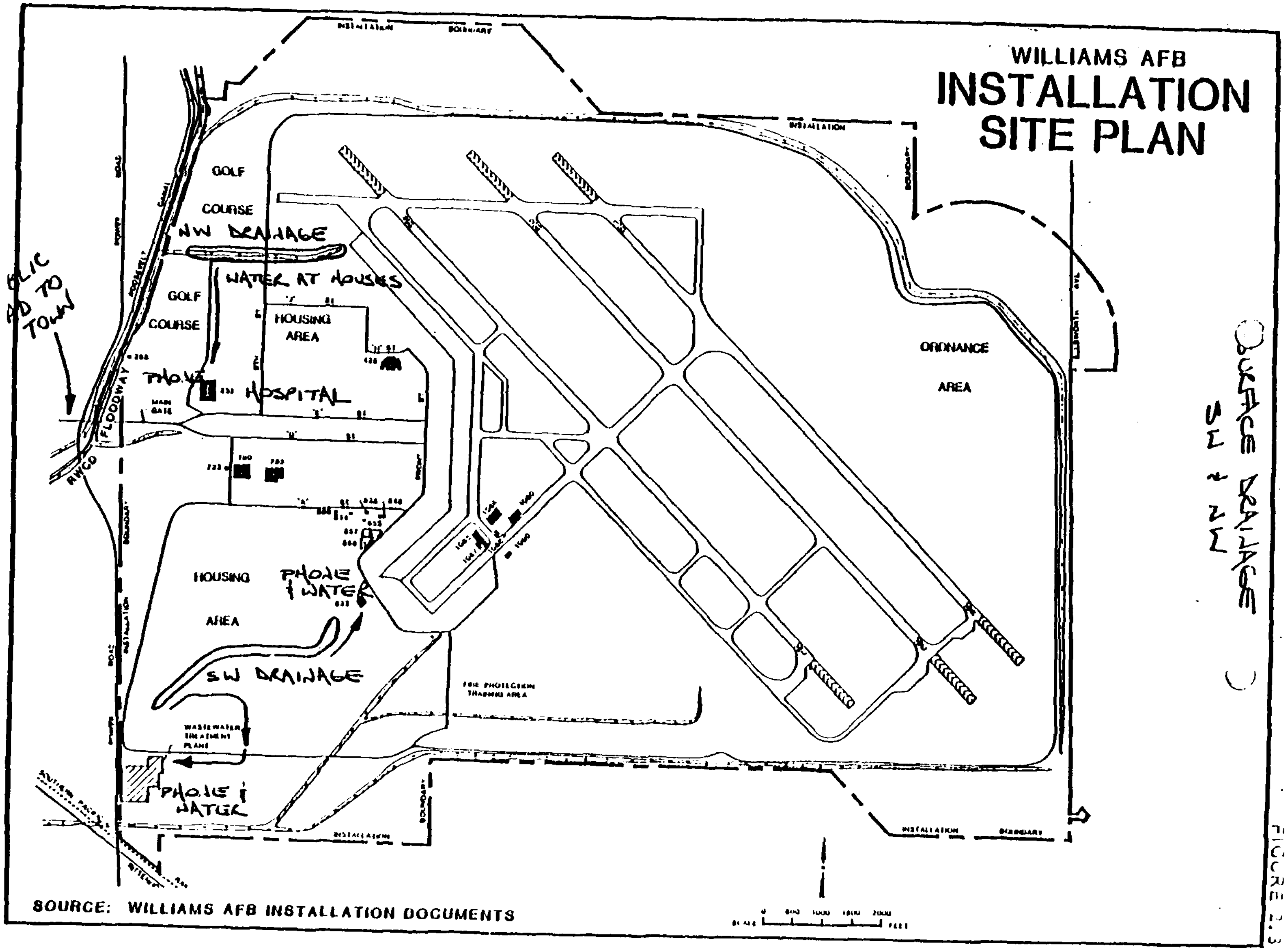
Public Road WILLIAMS FIELD ROAD RUNS WEST TO I-10

Provide Site Sketch (with all relevant facilities)

SEE ATTACH

* SEE FIRE PROTECTION AREA / LANDFILL SHEET FOR EXPLANATION

FIGURE 2.3


WILLIAMS AFB
INSTALLATION SITE PLAN
SURFACE DRAINAGE
SW & NW
GOLF COURSE
NW DRAINAGE
WATER AT HOUSES
GOLF COURSE
HOUSING AREA
PHONE
HOSPITAL
MAIN GATE
FLOODWAY
RWCD
HOUSING AREA
PHONE & WATER
SW DRAINAGE
WASTEWATER TREATMENT PLANT
PHONE & WATER
FIRE PROTECTION TRAINING AREA
ORDNANCE AREA
INSTALLATION BOUNDARY
SOURCE: WILLIAMS AFB INSTALLATION DOCUMENTS

SAFETY CONSIDERATIONS

If there is more than one level of hazard, or if there are multiple "sites" within a "site," a separate page 3 and 4 should be completed to show specific safety considerations for each location.

Work Location LIQUID FUELS STORAGE AREA

Objective of Work at This Location • COLLECT SOIL SAMPLES FROM 2 20' BORINGS AND 7 10' BORINGS AROUND FUEL LEAK OR SPILL AREAS IN THE ACTIVE STORAGE AREA

Level of Protection Planned: ___ A ___ B ___ C ✓ D

Possible Modifications UPGRADE TO C OR B AS NECESSARY

Surveillance Equipment:

✓ OVA (CONTINUOUS) ✓ O_2

✓ Explosimeter (CONTINUOUS)

Body Coverings to be Used:

Type of Boots: STEEL TOE LEATHER

Type of Gloves: SURGEONS AND BUTYL RUBBER

Type of Face Protection: SAFETY GLASSES

Type of Coveralls: COTTON, UPGRADE TO CHEMICAL OR TYVEK IF NECESS.

Additional Gear: LEATHER GLOVES FOR DRILLERS

Work Party:

Name	Responsibility	Level of Protection
DOUG TAYLOR	SAFETY	D *
TIM O'GARA	SAMPLE COLLECTION	D
DRILLERS (2)	" "	D *

* POSSIBLE UPGRADE

Site Entry Procedures COORDINATE ENTRY W/ USAF PERSONNEL CHECK WITH MAIN GATE AT START & END OF DAY

Call CAPT BURNS Before Entering, At: 988-2611 (Phone No.)

AV-F-HS07c

Criteria for Changing Protection OVM READINGS > 5 PPM ABOVE BACKGROUND WILL BE CAUSE FOR APR >50 PPM ABOVE BACKGROUND WILL REQUIRE SCBA* (BREATHING ZONE)

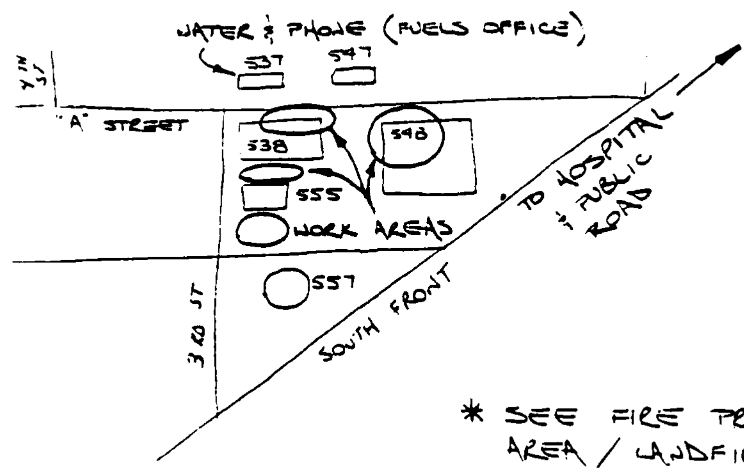
Decontamination Procedures WASH DRILLING EQUIPMENT WITH HOT HIGH PRESSURE WASH, WASH SAMPLING EQUIP & GLOVES/BOOTS WITH WATER & ALKANOX

Work Limitations (Time of Day, etc.) DAYLIGHT, BREEZY NOT WITHIN 50' OF TANKS WITH DRILL RIGS OPEN ALL GATES IF WORKING INSIDE FENCES

Disposal of Disposable Materials, Drill Spoils, Decontaminated Water, etc.
FIELD DECISION WILL BE MADE BASED ON OVM READINGS AND VISUAL CHECKS WHETHER CUTTINGS SHOULD BE DRUMMED OR PLACED IN LANDFILL AREA

Location of Nearest Phone FUEL MANAGEMENT OFFICE N OF "A" ST
Nearest Water " " " " " "
Public Road WILLIAMS FIELD ROAD, RUNS WEST TO I-10

Provide Site Sketch (with all relevant facilities)



* SEE FIRE PROTECTION AREA / LANDFILL SHEETS FOR EXPLANATION

SAFETY CONSIDERATIONS

If there is more than one level of hazard, or if there are multiple "sites" within a "site," a separate page 3 and 4 should be completed to show specific safety considerations for each location.

Work Location PESTICIDE BURIAL AREA

Objective of Work at This Location CONDUCT GEOPHYSICAL SURVEY OF THE AREA. NO SAMPLING OR DIGGING

Level of Protection Planned: ____ A ____ B ____ C ✓ D

Possible Modifications NONE

Surveillance Equipment:

NO	OVA	NO	O_2
NO	Explosimeter		

Body Coverings to be Used:

Type of Boots: STEEL TOE LEATHER

Type of Gloves: LEATHER

Type of Face Protection: NA

Type of Coveralls: NA

Additional Gear: NA

Work Party:

Name	Responsibility	Level of Protection
SUBCONTRACTOR TEAM	ALL WORK	D
NO	AF PERSONNEL WILL WORK AT THIS SITE	

Site Entry Procedures COORDINATE WITH AF AAD USAF BEFORE ENTERING AND LEAVING SITE EACH DAY

Call CAPT BURNS Before Entering, At 983 - 2611 (Phone No.)

Criteria for Changing Protection NO CHANGES, OPEN FIELD AREA WITH GOOD AIR CIRCULATION NO DIGGING OR INTRUSIVE WORK

Decontamination Procedures
NONE NECESSARY

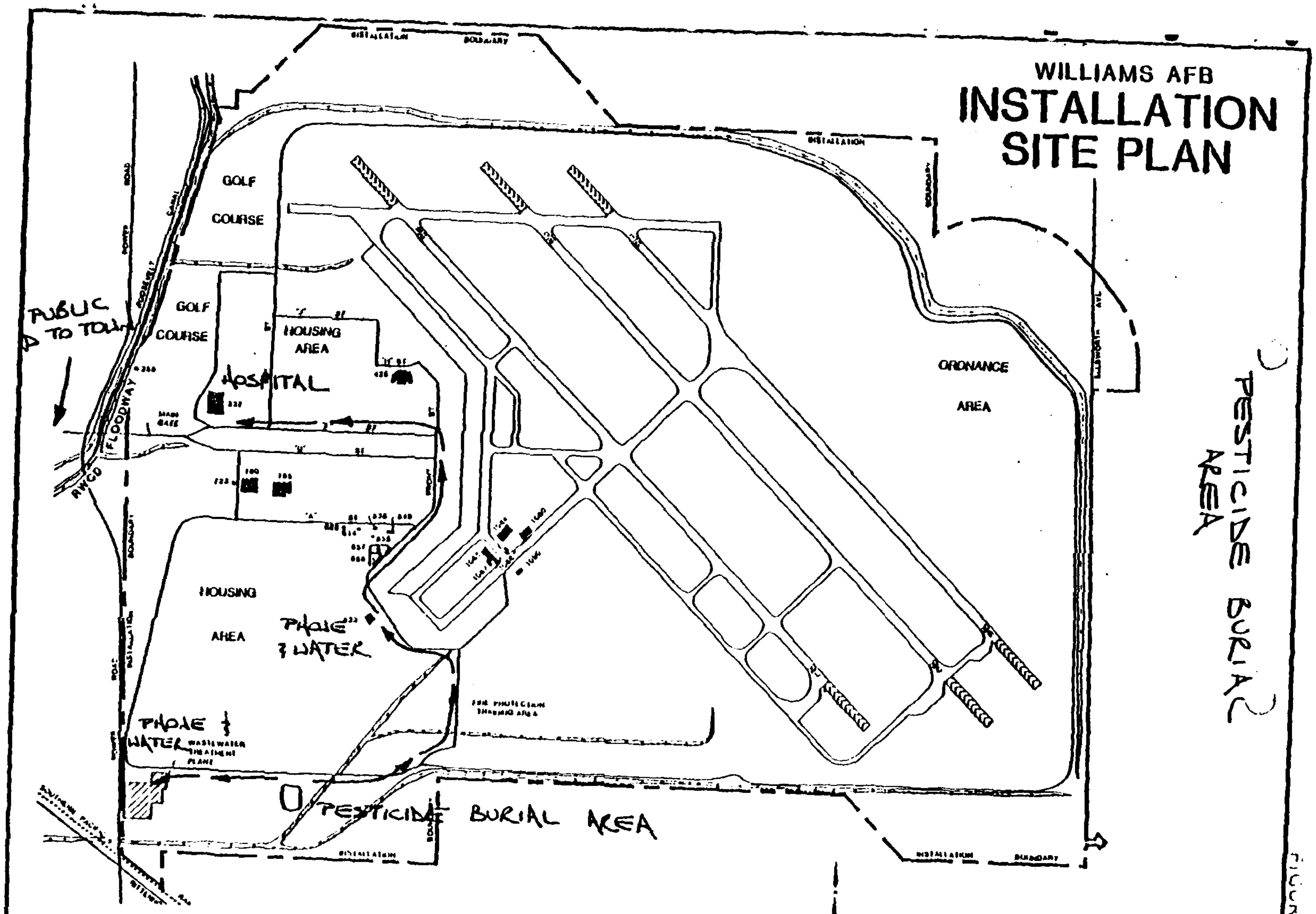
Work Limitations (Time of Day, etc.)
DAYLIGHT

Disposal of Disposable Materials, Drill Spoils, Decontaminated Water, etc.
NA

Location of Nearest Phone WASTEWATER TREATMENT PLANT
Nearest Water " " "
Public Road WILLIAMS GATE ROAD RUNS WEST TO I-10

Provide Site Sketch (with all relevant facilities)

FIGURE 2.3



SOURCE: WILLIAMS AFB INSTALLATION DOCUMENTS

EMERGENCY PLANNING

Phone Numbers

Pacific Bell Credit Card	666 152 0816 3452
Local Police	
Local Ambulance	ON BASE
Local Fire Dept.	
Local Hospital	
Local Airport	602-273-3300
Client Contact	1-800-321-4528 (BROOKS) 602-988-2611 (WILLIAMS)

Is there a phone at the site? YES If yes, number 602-988-2611
(Report this number with your supervisor and receptionist before leaving for the field)

Emergency Phone Numbers

AeroVironment Office	(818) 449-4392	MONROVIA 818-357-9983
Home of: CHS* Officer	818-797-2634	
Director, Env. Projects	818-799-6486	
V. P. Env. Programs Div.	818-799-6126	
Exec. V.P.	818-799-6572	
Company Physician	NA	
Med-Tox Consultants	714-669-0620	
Subcontractor's Office		

Hospital Route (attach map with route highlighted):

Provide directions to nearest available medical facility:

WILLIAMS AFB HOSPITAL IS LOCATED ON THE BASE JUST INSIDE THE MAIN GATE ON THE NORTH SIDE OF E ST (MAIN ROAD THRU BASE)

* SEE MAPS ATTACHED TO THE PAGE 3/4 SETS

*Corporate Health & Safety

AV-F-HS07e

END

DATE
FILMED
6-86

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